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Overhead Versus Underfeed in Hot Water Heating

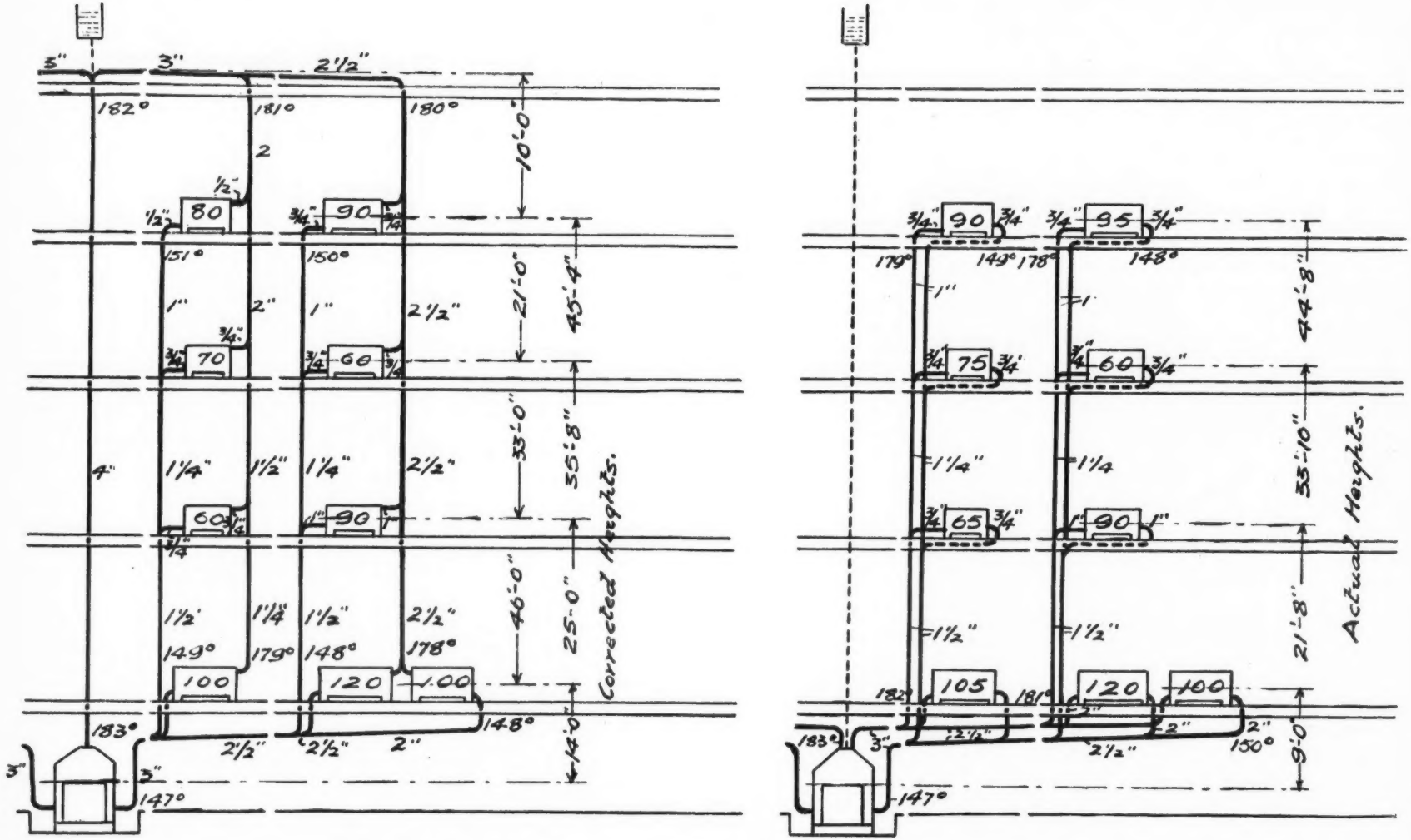
BY KONRAD MEIER

At the last semi-annual meeting of the American Society of Heating and Ventilating Engineers, one of the topics in order was the ever-recurring question: "Can the area of mains in overhead systems of hot water heating be reduced with benefit?" According to the reports the discussion of the theme was very brief and did not go into the subject far enough to show in what cases such reductions are practicable and why they may be made. The editor's request for information on these points may, therefore, be appreciated.

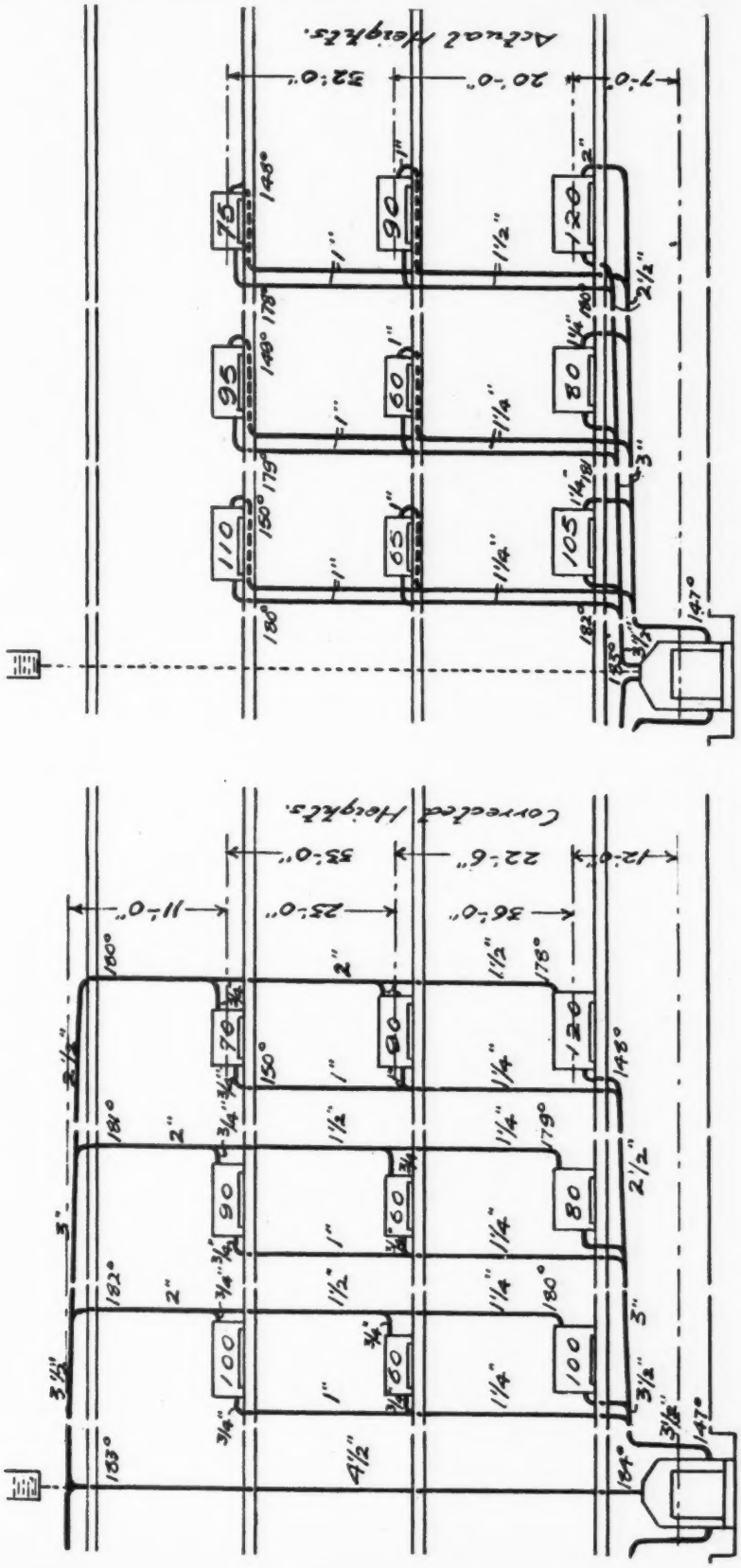
The pipe sizes in a hot water heating system circulating by gravity are determined naturally by the velocities obtainable in the different parts of the system. These velocities depend upon four principal factors. First, the differences of temperature between the rising and descending columns of water or their relative density. Second, the heights of these columns of water as given by the relative levels of boiler and radiators. These heights of fall combined with the weight represent the motive power available for circulation. The third factor is the resistance to the flow of water within the system, depending upon the actual velocity. The fourth factor is the energy expended in producing the motion itself. In gravity systems this latter is generally a negligible item. The two last-named factors, or the sum of friction and velocity heads, must always counterbalance the product of the two former, which may be called the pressure head. In other words, the friction head due to the actual velocity cannot exceed the pressure head available.

THE DIFFERENT CONDITIONS THAT OCCUR IN PRACTICE

A definite answer to the question may therefore be obtained by considering the bearing of these factors on the two methods of distribution. For this purpose it is only necessary to calculate closely the actual velocities obtainable with each system by means of well-known formula and data. Unfortunately the accurate rules and tables for sizing pipes are too complex for general use in planning, but in unusual cases the exact method based on the above-mentioned dynamic principles should always be used. This has been done in the five examples printed herewith which are intended to represent different conditions occurring in practice. In these examples the efficiency of the radiating surface has been assumed uniformly at 200 B.T.U., and as resulting in practically the same difference of temperature, 30° F., between flow and return ends of radiators. Allowance was made for the heating effect of the main rising line and pipes in attic by adding equivalent heating surface to the underfeed apparatus, so that these examples should actually give a fair comparison. The



FOUR-STORY OVERHEAD AND UNDERFEED SYSTEMS OF HOT WATER HEATING



THREE-STORY OVERHEAD AND UNDERFEED SYSTEMS OF HOT WATER HEATING

mains in cellar and attic are supposed to be insulated while the rising lines are assumed to be unfelted, but built into chases and furred over. The temperatures in the different parts of the systems have been calculated approximately on the basis of these assumptions and should be near enough the truth for the purpose of determining the velocities. It may be needless to state that all horizontal distances and common obstructions to the flow are assumed to be the same on either side.

FOUR-STORY OVERHEAD SYSTEM

It will be noted on the schedules, that the four-story overhead system does not show any reduction of pipe sizes as compared with the underfeed apparatus opposite, except in one single radiator connection on the top floor, where for practical reasons the size would not be reduced. The additional friction in the mains, especially in the main riser, offsets the motive power gained through the additional pressure head due to the cooling effect in the vertical flow pipes above the radiators. The additional head of 46 feet for the radiators on the first floor, with a mean difference of temperature of about $3\frac{1}{2}^{\circ}$ F. below that in the main riser has the same effect as if the radiator at the extreme end were placed about 5 feet higher, hence the corrected height of 14 feet as given. For radiators on rising lines nearer to the boiler this drop in temperature is smaller and the corrected height would be reduced correspondingly. It is evident that in similar cases the overhead system is practically certain to prove more expensive and for still taller buildings quite conceivable that even larger mains may be required for that system.

THREE-STORY EXAMPLE

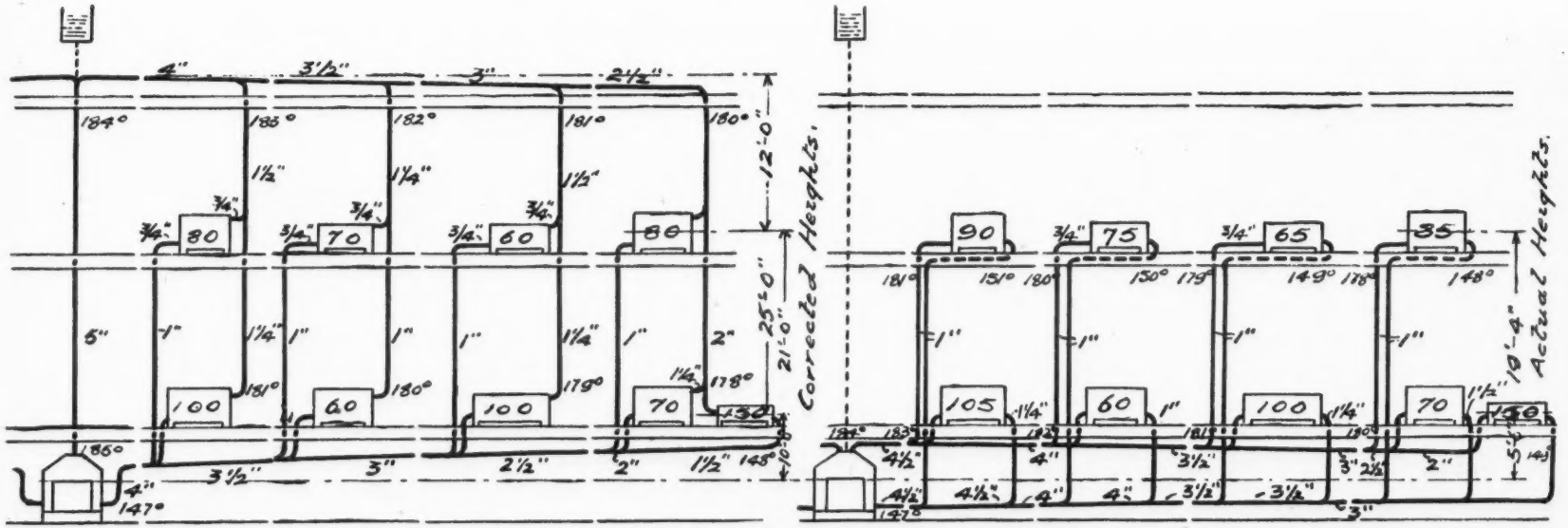
Turning to the three-story example, we note that the mains still figure about the same size, but that several of the individual radiator connections for the overhead scheme can be reduced. As these small sizes are not always advisable for practical reasons, no saving is likely to be effected in that direction, while the mains on the whole will be found longer and the total cost higher. This instance points to the reason why overhead systems are more difficult to adjust, especially when the radiator connections on upper floors are put in larger than the theoretical need.

REDUCTION OF PIPE SIZES IN TWO-STORY PLAN

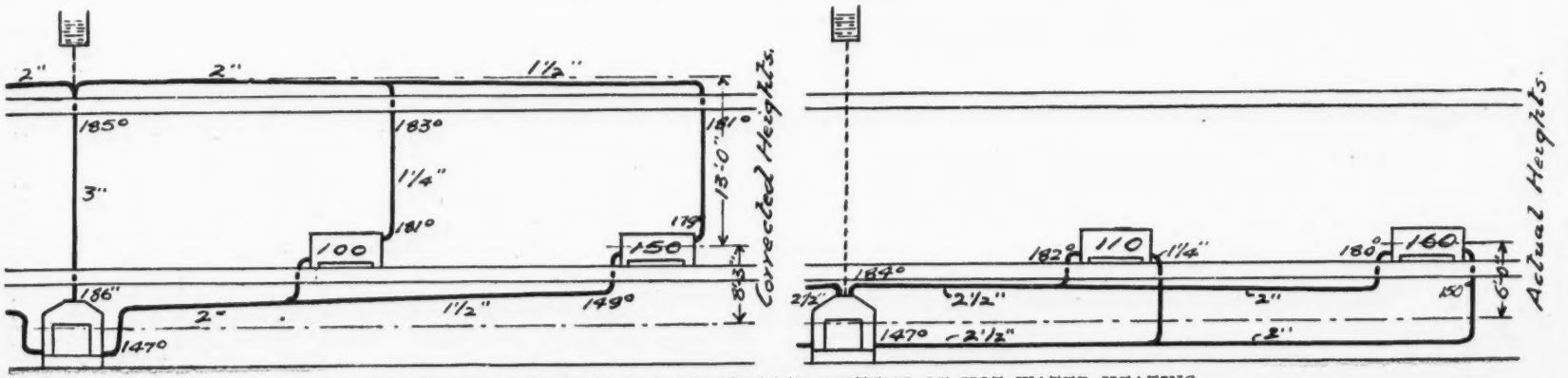
The two-story schedules finally show a decided reduction of pipe sizes for the overhead distribution, in mains as well as radiator connections. This is partly due to the selection of a very low height of cellar, the reversing of the pitch in the flow main, and the placing of the return mains below the level of the boiler, all of which are conditions unfavorable to the underfeed system. On account of the long horizontal runs the descending risers show a greater drop in temperature from that of the main riser. The corrected height of the farthest radiator becomes relatively and actually greater, probably doubling that of the corresponding radiator fed from below, if we also take into account the cooling in the return main below the mean level of the boiler which retards the circulation. The negative pressure head due to this latter cause might be calculated from the drop of temperature within the return main and the height to which the water must be lifted again. Usually this is a negligible factor, but it should nevertheless be considered in extreme cases. The effect of reversing the pitch is practically beyond calculation, depending upon the amount of air liable to collect, or the opportunities for its expulsion.

ONE-STORY EXAMPLE

The three foregoing examples are taken to aggregate the same heating surface and the same number of radiators in order to illustrate incidentally the effect on the pipe sizes of the mean height of heat-

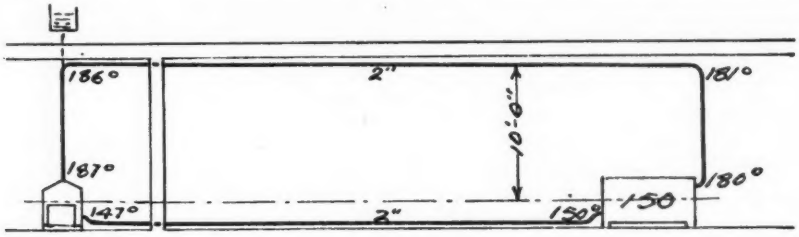


TWO-STORY OVERHEAD AND UNDERFEED SYSTEMS OF HOT WATER HEATING



ONE-STORY OVERHEAD AND UNDERFEED SYSTEMS OF HOT WATER HEATING

ing surfaces above the boiler. For the one-story example a simpler arrangement was selected. As in the preceding scheme the pipe sizes show a reduction in favor of the overhead system, and if the rising lines or drops can be utilized as heating surface the overhead feed should generally be the more economical to install. For one and two-story buildings structural conditions such as height of cellar, availability of attic, etc., will practically decide the point.



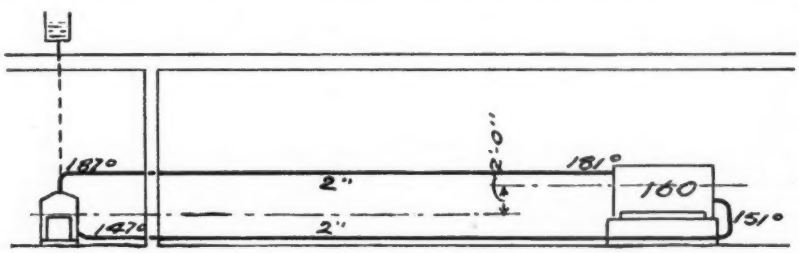
ONE-STORY OVERHEAD SYSTEM WITH BOILERS AND RADIATORS ON THE SAME LEVEL

GRAVITY CIRCULATION

Sometimes the problem is presented of obtaining a gravity circulation between boilers and radiators placed on the same level. Theoretically this is impossible, that is, if the mains and risers were perfectly insulated. If, however, the mains are utilized for radiation, or allowed to emit heat, and are placed at a higher level, the pressure head created solely by the drop of temperature in the piping will be sufficient to overcome the friction, if the pipe sizes are taken large enough to reduce the resistance correspondingly. Thus the one-story example shows the height which may effectively be gained by the overhead main and drop exposed as heating surface. In order to create the same circulation without raising the flow pipe the radiator would have to be elevated about 2 feet above the boiler, as shown in the sketch below. It is evident that the overhead feed is the only practicable method for the individual heating of flats and similar cases, excepting artificial circulation.

WHEN OVERHEAD DISTRIBUTION IS ADVANTAGEOUS

According to these five illustrations, or answers to the question, overhead distribution would be advantageous, or allow a reduction of pipe sizes only in low buildings, more particularly where the bulk of radiation is located at considerable horizontal distance from the boiler and where the heat emitted from the flow mains and drops may be utilized and need not be wasted for the sake of creating circulation.



ONE-STORY SYSTEM WITH RADIATOR TWO FEET ABOVE BOILER

The same relation would still maintain if the difference of temperature between flow and return at radiators is larger or smaller than 30° F. The reason why a flow main first rising to the attic has so generally been found to carry more radiation is to be obtained elsewhere. Thus far it has been assumed that

the circulation is created strictly by differences of temperature in the water. If, however, the water temperature is raised to a point where vapor or steam begins to generate, a new factor bearing on the circulation comes into play. The slightest bubbles of a lighter fluid ascending in the main directly to the attic naturally gives the overhead distribution a decided advantage by reducing the density of the rising column for the entire height, while such bubbles of steam are likely to be condensed or caught in the radiators of an underfeed system and do not help the circulation as much. Bubbles of air may even retard the circulation unless properly taken care of. To design an overhead system with smaller piping than that which would balance the pressure and friction heads as outlined, is simply to rely on temperatures rather near the boiling point, thus practically turning the system into one with artificial circulation, on the same principle as the modern methods of injecting steam, although this may not be the avowed intention. While in taller buildings this can be done with a certain degree of impunity, the practice is not advisable, except in extreme cases when compelled by unfavorable conditions.

LARGE SIZES FOR MAINS IN OVERHEAD SYSTEMS

If the principal advantages of hot water heating, such as low temperature of heating surface, freedom from noise, and to an extent also economy in operation, are not to be sacrificed, the mains in overhead systems should not be reduced except in comparatively low buildings where the distributing pipes are not materially longer and where they can be utilized as heating surface and thus be relied upon to accelerate the circulation by gravity.

Air Pipes, Sizes Required for Low Velocities

By J. H. Kinealy

After we have determined the pressure required to overcome the resistance to friction, bends and other obstructions to the flow of air in a pipe we must determine the pressure required to give to the air the velocity which it has when it leaves the pipe, and the sum of these will be the total pressure required to deliver the desired amount of air through the pipe. Of course, if the pipe is the same size from end to end, the velocity at the entrance will be the same as that at the end or point of delivery, but in the case of a branched system of pipes the velocity in the main at the point where the air enters is almost always greater than that at the end where the air leaves the branch, and it is this last velocity with which we are concerned.

ALLOWANCE FOR LOSS OF PRESSURE

It is necessary also to make some allowance for loss of pressure at the point where the air enters the pipe, especially if the pipe leaves a chamber similar to a plenum chamber. But if there is no chamber and the pipe is simply a continuation of the outlet of the fan no allowance for entrance need be made. When the pipe leaves a large chamber the resistance to entrance may be assumed as equal to the friction in a pipe whose length in feet is three times the size of the pipe in inches for a square pipe, or three times the diameter of the pipe if it is round.

When the velocity of the air through the pipe is low the pressure required to produce this velocity amounts to very little, but when the velocity is high the pressure required to produce it must not be overlooked.

PRESSURES REQUIRED UNDER VARYING CONDITIONS

Thus the theoretical amount of air that will be delivered per minute through a pipe 6 inches square

and 100 feet long with a loss by friction of 0.3 of an ounce pressure per square inch, is 317 cubic feet, and the velocity of the air leaving the pipe will be 1,270 feet per minute. Now the pressure required to overcome the friction is 0.30 of an ounce and the pressure required to give the velocity to the air is 0.06

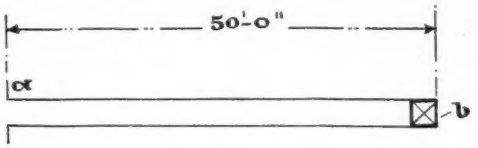


FIG. 1

of an ounce, so that the total pressure required is 0.30+0.06 or 0.36 of an ounce.

The theoretical quantity of air per minute that will be delivered through an 18-inch square pipe 100 feet long with a loss by friction of 0.3 of an ounce per square inch is 4,970 cubic feet, and the velocity of the air leaving the pipe will be 2,210 feet per minute. The pressure required to overcome the friction is 0.30 of an ounce and the pressure required to give the velocity of 2,210 feet per minute to the air is 0.18 of an ounce, so that the total pressure required is 0.30+0.18 or 0.48 of an ounce per square inch.

So also, the theoretical quantity of air per minute that will be delivered through a 48-inch square pipe 100 feet long with a loss by friction of 0.30 of an ounce is 57,600 cubic feet, and the velocity of the air leaving the pipe will be 3,600 feet per minute. The pressure required to give this velocity to the leaving air is 0.48 of an ounce per square inch, and since the pressure required to overcome the friction is 0.30 of an ounce per square inch, the total pressure required is 0.30+0.48 or 0.78 of an ounce per square inch.

METHODS OF DESIGNING SYSTEMS OF PIPING

These examples show that it will not suffice to consider only the pressure required to overcome the friction, and also show how necessary it is that the pressure required to give the air the velocity with which it leaves the pipe should be considered when determining the total head required. The usual method followed by engineers in designing a system of piping is to assume a certain velocity for the leaving air and also certain velocities for the branch pipes and main pipes, and then determine the pressure required to overcome the friction in each part and add all together to get the total pressure required to deliver the air. This is a laborious method and is not to be recommended, it is better to assume the total pressure allowable and then make the pipes to suit. This may be done by the use of formulas or tables.

CALCULATIONS FOR DELIVERY OF AIR

The following table gives the amount of air in cubic feet that can be delivered through square pipes of different sizes and various lengths when the total pressure to overcome friction as well as to give velocity to the air is 0.3 of an ounce per square inch. When calculating this table allowance was made for the resistance due to seams, joints, rivets and other obstruction whose actual resistance to the flow of air it is almost impossible to calculate, by multiplying the theoretical amount of air that would be delivered by a perfectly smooth, straight pipe by

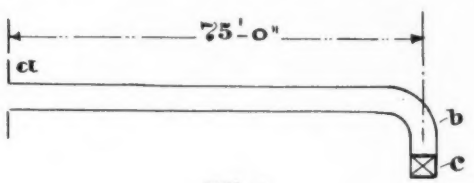


FIG. 2

0.9. In other words a factory of safety of about 0.1 has been used, and the amounts of air given in the table are 0.9 of the theoretical amounts.

The table has been calculated for a total pressure of 0.3 of an ounce because that is an ordinary pressure to be used when designing schools, hospitals, churches and

similar buildings, when the fan delivering the air is run at a speed corresponding to a pressure of about 0.5 of an ounce per square inch. For factory work, a higher total pressure may be used, because a fan in a factory is seldom run at a speed corresponding to a less pressure than 0.75 of an ounce per square inch.

The following examples will illustrate how the table should be used to proportion the pipes of a system:

TABLE SHOWING AMOUNT OF AIR IN CUBIC FEET THAT CAN BE DELIVERED THROUGH SQUARE PIPES OF DIFFERENT SIZES AND LENGTHS WHEN TOTAL PRESSURE IS 0.3 OF AN OUNCE PER SQUARE INCH

Size of Pipe in ins.	Area in Square Inches.	Length of Pipe in Feet. 50	100	150	200	300	400	600	900	1200
6	36	350	260	220	195	160	140	115	95	85
8	64	680	530	450	395	330	290	240	185	170
10	100	1140	900	770	680	570	500	415	340	290
12	144	1730	1380	1190	1050	890	780	650	530	465
14	196	2420	1950	1670	1480	1260	1110	950	760	660
16	256	3310	2710	2370	2120	1780	1570	1310	1090	950
18	324	4330	3580	3110	2800	2380	2120	2030	1460	1280
20	400	5400	4550	4000	3600	3100	2730	2280	1890	1660
22	484	6700	5660	4980	4520	3860	3440	2880	2380	2090
24	576	8100	6900	6100	5530	4750	4230	3550	2960	2590
26	676	9700	8270	7380	6680	5770	5130	3610	3600	3160
30	900	13300	11500	10300	9360	8100	7250	6120	5130	4500
34	1156	17400	15200	13700	12500	10900	9720	8300	6950	6100
38	1444	22000	19300	17500	16100	14000	12700	10800	9100	8000
42	1764	27300	24200	22000	20300	17900	16100	13800	11700	10300
46	2116	33200	29700	2 200	25000	22100	20000	17100	14500	12800
50	2500	39400	34500	32500	30400	27000	24500	21000	17800	15800

EXAMPLE 1

Fig. 1 shows a straight pipe connected at *a* to a plenum chamber and at *b* to a vertical riser. The pipe is 50 feet long and the riser is 10 feet, and the connection at *b* is a square elbow. The problem is to determine the size of square pipe required to convey 500 cubic feet of air per minute through this pipe and riser with a pressure in the plenum chamber of 0.3 of an ounce per square inch. The coefficient for entrance is 3, and that for the square bend at *b* is 5, so that the length of the pipe and riser must be increased by 8, equal 3+5, times the size of the pipe. The length of the pipe and riser is 60 feet, and it is probable that when we add the equivalent length for the entrance and bend the total equivalent length of the pipe and riser will be at least 100 feet. Now we look in the table under the column headed 100, and find 530 opposite an 8-inch pipe. In other words it is likely that we must use an 8-inch pipe. To make sure, we multiply 8 by the sum of the coefficients for entrance and the bend or by 3+5, and get 64. The total equivalent length of the pipe is therefore equal to the length of the pipe and riser, which is 60, plus 64, or to 124 feet. Now the table does not give the number of cubic feet an 8-inch square pipe 124 feet long will deliver, but it shows that an 8-inch pipe will deliver 530 cubic feet a distance of 100 feet, and 450 cubic feet a distance of 150 feet. Hence we are safe in saying that an 8-inch pipe will deliver 500 cubic feet a distance of 124 feet, and it is the pipe required.

EXAMPLE 2

Fig. 2 represents a pipe and riser through which we wish to deliver 1,000 cubic feet of air with a pressure in the plenum chamber of 0.3 of an ounce per square inch. The length of the pipe is 75 feet and the length of the riser is 10 feet, so that the actual distance which the air must be carried is 85 feet. Since the pipe leads from a plenum cham-

ber the coefficient for entrance at *a* is 3. The bend at *b* may be assumed to be an ordinary round bend whose coefficient is 3, and the connection to the riser at *c* is a square bend whose coefficient is 5. To allow for entrance and the friction of the bends the actual length of the pipe and riser must be increased by 11, equal 3+3+5, times the size of the pipe in order to get the total equivalent distance through which the air must be carried. By way of trial we assume that the equivalent length of the pipe will be 200 feet. Then looking in the table down the column headed 200 we find that a 12-inch pipe will deliver 1,050 cubic feet of air per minute a distance of 200 feet. We must now see if our total equivalent distance will exceed our assumed distance of 200 feet if we use a 12-inch pipe. The actual distance is 85 feet and the distance equivalent to the bends and entrance is 11 times 12, or 132 feet, making the total equivalent distance 85+132, or 217 feet. That is, our actual total equivalent distance is a little more than our assumed total equivalent distance, about 10 per cent. more. The total shows that a 12-inch pipe will deliver 1,050 cubic feet a distance of 200 feet, and 890 cubic feet a distance of 300 feet. Increasing the distance by 100 feet from 200 to 300, reduces the amount of air delivered from 1,050 cubic feet to 890 cubic feet. That is a difference of 160 cubic feet, equal 1,050-890, for an increase in length of 100 feet, or a decrease of 16 cubic feet for each 10 feet increase of length. So that an increase in length of 20 feet means a reduction in the amount of air delivered by the 12-inch pipe of about 32 cubic feet. Hence, since the 12-inch pipe will deliver 1,050 cubic feet a distance of 200 feet it will deliver about 1,018, equal 1,050-32, cubic feet a distance of 220 feet. We may use a 12-inch pipe for the case shown in Fig. 2.

These examples show how to use the table, and it is evident that one will soon learn to determine very quickly about what distance to assume when getting the trial size of pipe. It is impossible to give any particular rule or method of determining by what amount the actual length of a pipe must be increased in order to compensate for the resistance due to the bends and other obstruction, other than the one explained of multiplying the size of pipe by a coefficient for each bend or obstruction. It is easy, however, to determine the sum of the various coefficients and then choose a size of pipe and multiply it by the sum of the coefficients mentally and at the same time add the product to the actual length of the pipe. It must be remembered that if the assumed total length of the pipe is less than figured, the problem must be gone through again and again until the assumed length is greater, or equal to the calculated total equivalent.

It is hardly necessary to say more about single pipes, as the examples that have been given indicate clearly the method to be pursued with them. In the case of long mains with branches at irregular intervals there is some slight difference between the method to be followed for the branches and that for the main.

Each branch is to be handled exactly as if it were a single pipe running from the plenum chamber or the fan to the outlet, without regard to the fact that it joins onto a main. The main is to be calculated as if it were a part of the longest branch measured from the plenum chamber or the fan as the case may be, to the outlet of the longest branch. In speaking of length we always mean the equivalent length after allowance has been made for the effect of the various bends and other obstructions.

EXAMPLE 3

Fig. 3 represents a main with connections to two risers. The main connects directly to the outlet of a fan at *a*, so that there is no coefficient for entrance. At *b* the first

branch is taken off, and we may assume that the coefficient for this branch is 3. At *d* there is a bend whose coefficient we may assume is 3. At *c* and *e* where the branches connect to the risers we may assume that there are square bends for each of which the coefficient is 5. Let us suppose that each riser is 10 feet long and is to carry 500 cubic feet of air per minute.

To calculate the size of the branches, that is the parts from *b* to *c* and from *d* to *e*, assume that for each riser we have a separate pipe running entirely back to the fan at *a* and determine the size of pipe required, being careful, of course, to make the proper allowances for the bends.

For the riser at *e* the pipe is 110 feet long and the length of the riser

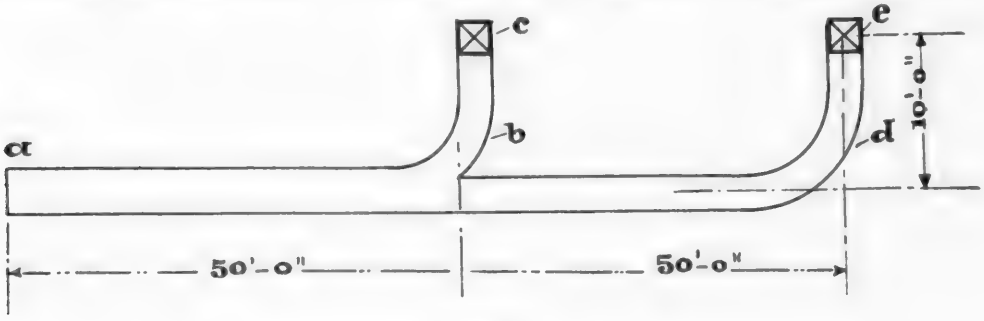


FIG. 3

added makes the total length 120 feet, with a bend at *d* whose coefficient is 3, and a square bend at *e* whose coefficient is 5. Therefore the total equivalent length of this pipe is 120 feet plus 8 times the side of the pipe in inches. This will probably need a 10-inch pipe. If a 10-inch pipe is used its total equivalent length would be 120 feet plus 8 times 10, or 80 feet, equal to 200 feet. Now looking in the table under the column headed 200 feet, we find that a 10-inch pipe will deliver 680 cubic feet of air a minute, while we wish to deliver only 500 cubic feet. The 10-inch pipe is too large. An 8-inch pipe will deliver 395 cubic feet per minute a distance of 200 feet, and a 9-inch pipe will deliver about 540 cubic feet of air per minute a distance of 200 feet. This is about midway between the quantities that the 8-inch and 10-inch pipes will deliver. For a 9-inch pipe the total equivalent length will be 120 feet plus 8 times 9, or 72 feet, equal 192 feet. And the table shows that the 9-inch pipe will deliver 540 cubic feet of air 200 feet, and hence it will deliver somewhat more than 540 cubic feet a distance of 192 feet.

The branch to *c* is 70 feet long including the riser and has a bend at *b* whose coefficient is 3 and a square bend at *c* whose coefficient is 5. Hence the total equivalent length of the pipe and riser is 70 feet plus 8 times the size of the pipe in inches. It is evident since this pipe is not to deliver more than 500 cubic feet of air per minute it need not be larger than a 9-inch pipe, the same as the branch leading to *c*. If it is an 8-inch pipe its total equivalent length would be 70 plus 8 times 8, or 64, equal 134 feet. Looking at the table we see that an 8-inch pipe will deliver 450 cubic feet of air per minute a distance of 100 feet. Hence an 8-inch pipe will not deliver quite 500 cubic feet of air per minute a distance of 134 feet. We must therefore use either a 9-inch or an 8x9-inch pipe. It is probable that in actual work we should use a 9-inch pipe, and by means of a volume damper at *b* make more air go towards *e* than towards *c*.

We have determined the sizes of the two branches and now it remains for us to determine the size of the pipe between *a* and *b* which must carry 1,000 cubic feet of air

per minute. That is, it must carry the sum of what goes to the two branches. The exact way to determine the size of the pipe between *a* and *b* would be to calculate the pressure required to give the air the velocity with which it leaves the riser *e*; then calculate the pressure required to overcome the friction from *b* to the outlet of the riser at *e*; then subtract the sum of these from 0.3 of an ounce; and then calculate the size of pipe which will deliver 1,000 cubic feet of air per minute with a loss by friction equal to this remainder. This, however, is a cumbersome and almost impractical method, so we use the following: Find the branch having the greatest total equivalent length and find the size of pipe that will deliver the quantity required to be carried by the main for that distance. Here, the greatest equivalent length is about 200, exactly 192 for branch to *e*, and hence we look in the table under the column headed 200 and find that a 12-inch pipe will carry 1,050 cubic feet. Hence we use a 12-inch pipe from *a* to *b*.

EXAMPLE 4

Fig. 4 shows a main with five branches, each connected to a riser 20 feet long and each to carry 750 cubic feet of air per minute.

The longest branch is from *a* to *f*. It has one bend whose coefficient is 3 and a square bend connection to the riser whose coefficient is 5. We will suppose that the main is connected to a plenum chamber at *a* so that there is a coefficient of entrance at *a* of 3. The distance from *a* to the outlet at the top of the riser at *f* is 280 feet, and the total equivalent length then is 280 feet plus 11, equal 3+5+3, times the side of the pipe in inches. It is pretty safe to say that the total equivalent length of the pipe will be about 400 feet, in which case we see that to deliver 750 cubic feet of air per minute we must use a 12-inch pipe. If a 12-inch pipe is used the total equivalent length will be 280+11×12 equal 280+132 or 412 feet. This is close enough to what we assumed, so that we may consider that the total equivalent length is 400 feet and use this distance to determine the sizes of the other parts of the main.

To get the size of the main from *d* to *e* we look in the table and find the pipe required to deliver 1,500 cubic feet of air, what goes out two risers, at a distance of 400 feet. We see that a 16-inch pipe must be used.

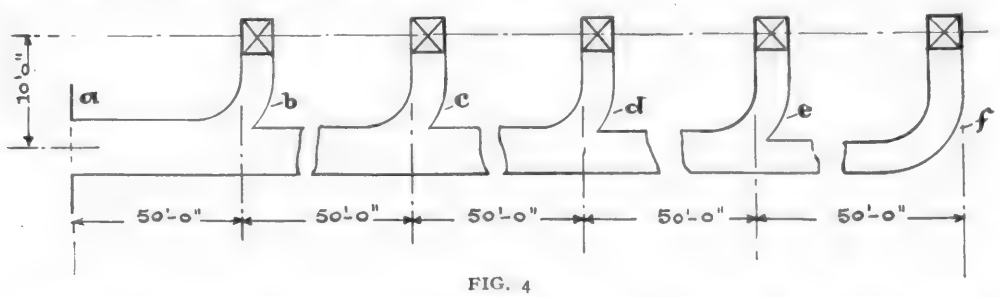


FIG. 4

To get the size of main from *c* to *d*, we find the pipe that will deliver 2,250 cubic feet a distance of 400 feet. An 18-inch pipe will deliver only 2,120 cubic feet and is therefore a little too small, although it might be used. A 20-inch pipe will deliver 2,730 cubic feet per minute and is too large. We must use either an 18x19-inch or a 19-inch pipe.

From *b* to *c* we must carry 3,000 cubic feet of air, and looking in the table under the column headed 400 we see that a 20-inch pipe is somewhat small and a 22-inch pipe is too large. A 21-inch pipe is just about right.

From *a* to *b* we must carry 3,750 cubic feet of air per minute, and looking in the table under the column headed 400 we see that a 24-inch pipe is too large and a 22-inch

pipe too small. A 23-inch pipe is about right.

Hence from *a* to *b* we use a 23-inch pipe; from *b* to *c*, a 21-inch pipe; from *c* to *d*, a 19-inch pipe; from *d* to *e*, a 16-inch pipe, and from *e* to the end, a 12-inch pipe.

This method gives sizes that are somewhat large, but not too large, and it enables us to quickly determine the sizes of a main which may safely be used, especially when it is better to have the pipe too large rather than too small.

It is unnecessary to go through the calculations for the other branches. They may all be made 12x12, or those at *b* and *c* may be made 11x11 inches and the others 12x12.

The table given here is for a total pressure of 0.3 of an ounce per square inch, and Professor Kinealy's next article will discuss the effect of increasing the pressure. A pressure of 0.3 of an ounce per square inch has been chosen because it gives large pipes and is convenient for use in schools, hospitals and other places where a low velocity of the air in the pipes is desired.—ED.

The Metric System in England—The American Argument Against It

The present agitation in England regarding the efforts to have the metric system made compulsory by law has aroused considerable interest in this country, and engineers are closely watching the course of events across the sea. A compulsory metric system bill has already passed the House of Lords and is at present before the House of Commons.

In view of the wide effect such legislation as that proposed would have on American exports to England, and indirectly, on American practice generally, it is peculiarly interesting to recall a paper on the metric system read some years ago by Coleman Sellers, of Philadelphia, before the American Society of Mechanical Engineers.

This paper is generally considered to be one of the strongest arguments against the adoption of the metric system, either here or in England, that has been made. It was, indeed, this paper that led to the adoption of a formal resolution by the mechanical engineers "deprecating any legislation tending to make its (the metric system) introduction obligatory into our industrial establishments."

Mr. Sellers said, among other things, "to the great bulk of mankind engaged in trade, in buying and selling, in bartering and exchanging, it matters little what system they adopt; it matters little whether they are obliged to use a yard-stick or a meter rod, pounds or kilograms, quarts or liters. The cost to them of a change from one to the other is the cost of the few devices needed in weighing and measuring; the rationale of the system may never enter their thoughts.

ENORMOUS SUMS REPRESENTED IN PRESENT MACHINES

"With the machinist the case is different. He must not only possess costly means of measuring and weighing, with a degree of exactness unknown to others, but the results of these weights and measurements are fixed and unalterable. Enormous expenditures on tools, on drawings, on patterns, on everything he uses in making or building his machines are on what is involved in the primary system used in determining weight and size. The product of this expenditure means everything that makes modern civilization possible. I propose to consider the subject only as it relates to our own profession; not in regard to its effect on the grocer, the dry goods man, or on the druggist. I propose to show why, after nearly twenty years' constant use of the metric system of measurement, I record my opposition to any enforcing legisla-

tion in this direction, because the metric system is not well adapted to the practice of the machine shop.

SCREWS CANNOT BE EASILY FIGURED METRICALLY

"Wm. Sellers & Co. make injectors for feeding boilers. They make them to the metric scale. Their instruments are made from drawings figured in millimeters in all parts, except where screws and screw threads are needed. Screws to be cut on existing lathes cannot be conveniently figured metrically, unless we adopt the custom of some German shops to figure in one dimension and make gauges to some other one. A screw bolt in Germany called 25 mm. diameter must be made 25.4 mm. size to conform to the screw system in use there; it will have 8 threads per inch and consequently 8 threads per diameter. Screws cannot be metrically divided, until metrically divided lead screws have been originated and put in the place of the inch-divided lead screws common to all lathes in all parts of the world.

"The people into whose hands these injectors pass know nothing of the scale of proportions to which they have been made. If some piece needs repairs and its shape has been lost by wear, it is needless to say that a knowledge of the scale would give no clue to that shape, but from some existing original any part can be copied; to copy requires no knowledge of the scale used. Repairs, too, as a rule, require deviation from original size to compensate for wear.

"While the value of the unit of measurement may be of little moment in repairs, it is, however, all important in the first production of machines.

SHOP AND MERCHANT SIZES

"In shop practice and in mercantile practice, to avoid an endless variety and confusion of sizes, certain dimensions in progressive order are adopted, being the sizes found most useful and most salable in practice. These progressive sizes we may call, in order to make the matter easily understood by 'advanced thinkers,' shop sizes and merchant sizes.

"It is by the use of well-considered ranges of shop and merchant sizes that the maximum of convenience is obtained at the minimum of cost. Hence one metrological system may be found to possess advantages over another when put to the test of practice. The one that is best in affording the most convenient and the most easily used and memorized series of sizes should not be called unphilosophical.

"Calculations based on the 'inflexible law of mechanics,' as read by finite man, intimates for the size of a certain part of some machine a dimension 3.95 inches diameter, the prudent engineer has possibly assumed a sufficiently ample factor of safety to permit him to select 3 15/16 inches, the nearest shop size below the theoretical size, 3 15/16 = 3.9375 inches. He desires to use this shop size, because 4-inch iron, an obtainable merchant size of bar iron, will clean up from the black to this size; but if his dimension relates to castings or forgings he may select 4 inches as a shade stronger.

"Metric-using people have ranges of shop and merchant sizes too; when I come to compare their possible series and their actual series with our own, some faint glimmer may come to those who now know nothing about the matter of the fact that our unphilosophic system is not so very bad after all.

"In regard to what is involved in each shop size, in a money point of view, I will give but one single example. The inquiry to our own tool-room keepers for a list of the separate devices used in producing one size, viz., 1¼ inch, brings to me the names of 129 articles or sets of articles, such as drills, reamers, gauges, boring bars and cutters, taps of all kinds for all sorts of uses, hardened mandrels, etc., etc. These many pieces, costing many

hundred dollars, represent one size only. They tally with and belong to the dimension marked 1¼ in many thousand places on drawings, which have been accumulating for years, to patterns loading down our pattern lofts, to gear wheels interchangeable over a continent, and to the output of our factory for years. So important in an economical point of view has come to be these shop-size series, that machines built in one shop, if to be reproduced (not repaired) in another, must be redrawn to conformity to the shop system in use before the work can be begun to advantage. Year by year this harmony in shop sizes in America spreads over a larger area. Entire harmony in essential points exists in many of the leading shops. There are, however, examples still to be found in which machines built in one shop have no dimensions in common with the shop sizes we use, as compared to our inch series or our millimeter series, for we use both. The expert recognizes such machines as having been built to gauges varied by the judgment of the master workman, or by the more costly method of fitting one piece to another already completed, a process not admissible in any well-regulated machine shop.

THE AMERICAN INCH

"The metrology of the American shops is based on the inch, and on it only. This dimension is cut up into minor parts by halving to any degree of subdivision, practically in shop sizes to 1/16; it is also divided into 10 parts and into 12 parts when such divisions serve any good end. All such divisions have their uses and lead to no confusion. The inch squared is the base of our strain and pressure. The inch cubed gives us capacities. Later, I will speak of 12 and 36 inches squared and cubed. This one unit, the inch and pound weight of 7,000 grains Troy, is all that a machinist needs to carry on his business. His inch is the same inch as is used in England and in the Russian machine shops. His pound is the pound in common use in England.

"In America we have dropped some needless weights and measures, just as we have seen fit to drop the letter u from some of our words. We do not use in the machine shop the ton of 2,240 pounds nor its quarter or its hundred weight; we do use a weight called 'ton of 2,000 pounds.' This is the factor weight in strains, and by it we sell machinery. Other trades may retain some of these useless things; I am speaking only of machine-shop practice.

THE MILLIMETER

"The unit of measurement in France and in Germany is the millimeter. It is not and cannot be the meter for the following reason: The great majority of all sizes used in the construction of any machine, whether it be big or little, are less than one meter. By the use of the millimeter only, decimals are avoided. Eight millimeters must be written 8 in the millimeter scale, while it must be written .008 in the metric scale. This is reason enough; for by the use of millimeters, only, confusion of signs is avoided, and the danger incident to decimals is avoided, hence all drawings are figured in millimeters only, up to dimensions measuring many thousand millimeters. This little dimension is then squared and cubed, or, ten or one hundred millimeters are squared and cubed, for the uses corresponding to our squared and cubed inch and foot. As may be expected, happy coincidences of conveniences are found in either system. Thus an ardent metric advocate instances that 1 kilo to the square centimeter is just one atmosphere. We say 15 pounds to the inch is an atmosphere. Neither one is right, but the 15 pounds to the inch is 1 per cent. nearer right than the other is. For a machinist who seldom uses atmospheres a happy coincidence on the other side will be of more service. It so happens that wrought

iron bars with parallel sides measure in square inches of this section just one-tenth of their weight in pounds per yard. Now, inasmuch as 'shapes' in iron are rated by the pounds per yard, for convenience in large structures, so it comes to pass that when we know the weight per yard of any wrought iron 'shape,' we know at once its sectional area. Inasmuch as compression and extension and factors of safety are involved in a knowledge of cross section, it is handy to be able to find it so readily—is it not? A shape iron, 80 pounds to the yard, has 8 square inches area of section. If it is good for 10,000 per square inch in extension we may load it with 80,000 pounds.

"I have set out to compare the two scales—to compare the two units, rather, after an experience of twenty years with both. The inch is 25.4 times larger than the millimeter. These are the two dimensions we are to compare.

EXPERIENCES IN THE DRAWING ROOM

"We will begin in the drawing room. Here 'the inflexible laws of mechanics' find their first expression in form on paper. Few machines, or even parts of machines, can be drawn full size. Hence comes the need of 'scales.' There is reason in all things, even in scales. The unwritten law of most machine shops is to make every drawing as large as possible, as near full size as the nature of the subject and the dimensions of the paper used will permit. We have in our drawing room about 125 drawers, each of which will take in, without folding, drawings 52 inches (1,320 mm.) long by 33 inches (840 mm.) wide. This is about as large a sheet as we can use to advantage, and tracings from these are not unmanageable in the workshop.

"For metrical drawings we can use the following scales only:

Full size in which.....	1 mm. = 1 mm.
One-half size in which.....	½ mm. = 1 mm.
One-fifth size in which.....	2 mm. = 1 cm. or 2 cm. = 1 dm.
One-tenth size in which.....	1 mm. = 1 cm. or 1 cm. = 1 dm.
One-twentieth size in which....	5 mm. = 1 dm.
One-twenty-fifth size in which..	4 mm. = 1 dm.
One-fiftieth size in which.....	2 mm. = 1 dm.

"Down to the one-tenth scale the dimensions can be read from a good millimeter rule, for the one-twentieth, the one-twenty-fifth and the one-fiftieth scales must be constructed. The jump from one-half to one-fifth size is unfortunate. Could we conveniently quarter the whole size we would have an increased area section, a matter of much moment. The ⅕ of 10 inches is 2 inches, and the square of 2 is 4. The ¼ of 10 inches is 2½ and its square is 6¼, a gain in size of over 50 per cent.; a gain in comfort, in convenience and in eyesight. Here we catch the first glimpse of the advantage of our own system; for with it a draughtsman can, from an ordinary well-divided inch rule, obtain the following scales: Full ½, ⅓, ¼, ⅙, ⅛, 1/12, 1/16, 1/24, 1/32, 1/48, 1/64—12 gradations, as compared to 7, and to these 12 can be added with perfect ease 5 of the others, making 17 in all, if the preference be for the decimally-divided inch, a scale carried in the tool box of every machinist, and obtainable from the two-foot rule in so common use.

"The scale series in most common use is that of ½, ¼ and ⅛: this halves down from whole size and can be raised, in rapid drawing, by taking off diameter sizes from one drawing and using them as radius dimensions in the other, a process impossible between ½ and ⅓ sizes.

"The true value of this extended series of scales, with its peculiar advantages, is manifest to any one familiar with both, and admits of

no dispute. Is it a wonder that draughtsmen brought up under a metric rule take so kindly as they do to our unphilosophical system?

"Drawing is but a small part of the engineer's work. More or less calculating has to be done; many hours must be spent in figuring strains, estimating weights, determining speeds and what not.

FIGURES IN THE MACHINE SHOP

"The value of the drawing-room system is tested or tried when the drawings reach the machine shop. It is there that errors are found out. An incorrectly figured drawing costs nothing on account of the errors so long as that drawing rests quietly in its drawer; but it costs fearfully when the error is discovered in the partially finished machine. All engineers agree on one thing, viz., the fewest possible figures that can be used to express dimensions clearly, the easier it is to work to the drawing, and the less liability to make mistakes. Beautiful as is a decimal system in calculation, and we all use it, save in mental arithmetic, it has been found advisable to avoid the use of decimals as far as possible on the drawings used in our workshops, even in metric-using countries. A misplaced point is an easy error to make, and may cause no end of trouble and expense.

"I had hoped for gain in the drawing room from the use of metric scales; I expected to find more than in the machine shop; I have been disappointed in both.

"In the machine shop we come to test the value of shop sizes and merchant sizes, or rather the series possible in both, with one or the other system. For what is in use abroad, we look to Germany rather than to France for information useful to us, inasmuch as in Germany the metric system was taken up at a late day, and was introduced in its entirety without shock. To united Germany anything was better than their frightful confusion of 15 inches in use, all differing from the inch still used with their screw threads, and differing from the inch of England. The metric system is incomparably better than their before entire want of any uniformity. With us the matter is very different, as will be seen more clearly as we advance. We divide our unit, in practice, into just what parts are best suited to express our practical wants, and the system in our machine shops is uniform over a continent.

"The first item of manufactured matter entering the machine shop door is bar iron. The merchant sizes of round, square, etc., in America, are by 1/16, by ⅛, by ¼, etc. In Germany, similar bars advance in size by 1 mm. up to 40, by 2 mm. from 40 up to 80, and by 5 mm. above 80. This system is memorizable by 40 and 80—by 1, 2 and 5. It is the best that can be done with a system tied up to an unhalvable scale. It does not agree with the English or American sizes except in a few sizes. The system of bolts, diameters and threads per inch, common or general over the continent of Europe, is that known as the Whitworth system. They still adhere to this system as they do to the English system of gas and steam pipes and their fittings. The Whitworth system pitches its threads to even numbers or half numbers per inch in length. These pitches are easily obtained from the lead screws of all lathes, which are 2, 4 or 6 threads per inch, as a rule. Having given up the inch, the Germans formulate their threads per diameter. For the names of the bolts, they must either retain their English names, and call a 25.4 mm. bolt one inch, or they must call it what it is, 25.4 mm., but some call it 25 mm., and make it .4 mm. larger. This inch bolt has 8 threads per inch, and, as the diameter, too, is 1 inch, it can be said to have 8 threads per diameter. A 1⅛-inch bolt measures 28.6 mm.; it may be called 29 mm. size; it must be cut out of 29 mm. iron, the nearest merchant size, with a loss of 4/10 of a millimeter. This loss don't

seem much, but the dies which have to cut it off tell the story very soon. The Whitworth scale gives the same pitch to 1⅛ and 1¼ screws, viz., 7 per inch. The exclusive metric shops call the one 7⅞ threads per diameter, and the other 8¾, and yet they are practically the same and must be cut with the same combination of change wheels on the lathe. Here is a precious example of what comes from trying to harmonize two systems under one nomenclature. The screw system in general use is so good, it has been so long in use, its disturbance would shock so many interests, that it is unwise to give it up, as unwise as it would be to adopt the American gas-pipe system in place of the English, or for us, for sake of uniformity with England and Germany, we should attempt to force the adoption of their system into our houses.

"Imagine the hue and cry if some 'benevolent despot,' for the good of mankind in general and Europeans in particular, should direct us to change our 'fittings' to English standards, none of which would fit the pipes we have in our houses. Why, we are even vexed enough if we are sold a 'sleeve' which will not fit a pipe put in place thirty years ago.

STANDARD SIZES IN AMERICA

"America has, for the last half century, been striving in its own way, towards equalization of its standard sizes. The immense railroad industries demand this. Standard wheels on standard axles—standard fit sizes for both—are all founded on an inch scale of sizes.

"The shop sizes in America harmonize with the merchant sizes and with convenience. We cannot change them. It would be unwise, I think, to do so in face of the obtainable metric sizes if we could.

"We have not adopted the Whitworth system of screws in America, and yet, by so doing we would place ourselves in harmony with all Europe. We recognize objections to the system, and when those objections were clearly pointed out by Mr. William Sellers, and he proposed a system free from the objections, his system was accepted by the committee of the Franklin Institute, and then by many departments of our government. Had the metric system shown itself to be the perfect system it is claimed to be, it, too, would have been taken up more generally at a time when it was easier to have done so than now.

"There is an irreconcilable discord between the inch and the divisions of the meter. The inch has become fixed to a greater extent in dollars and cents, in fitness and convenience, in this country than in Germany, and yet there, in some cases I have shown, it cannot be given up.

NO BENEFITS IN CHANGE

"As an engineer I can see no possible good to come to American machinists from the change. Its introduction exclusively would not diminish his labor in any way; it would not cheapen his product; it would increase its cost. It is in fact, however, so impossible, in view of existing matters and existing harmony in interchangeable matter, that should the metric standard be made the only legal standard in America to be used in buying and selling, the engineering establishments now in existence could not heed the law, but must perforce use their existing tools and gauges of precision, and continue to make material in conformity with existing matter.

"Our metrological reformers urge us to adopt a new system in place of our present one, a system that harmonizes in no way with anything we now use. This new system is practically based on a certain measure over 39 inches long. This is cut up into 1,000 parts, and 100 of these parts cubed gives their primary vessel of measurement. The contents of this vessel in distilled water under certain conditions is their pound weight. Had the English yard of 36 inches been so

treated it would have been as good a system, but no better. It would have been as inapplicable comfortably to our profession as is the metric. The wonderful extension of the metric system to time and infinite space was given up as impracticable long ago, and we are now asked to bear the shock of a mighty change to use this inconvenient system, this unhandy system of ten, for the sake of uniformity with some other people's of the world.

"In conclusion, when we take into consideration the enormous interests involved in manufacturing in America; if it is, as we think, unwise to tamper with the existing metrology of our workshops, the question may well be raised as to the wisdom of enforcing the metric system in trade generally. The practical mind of Americans has already dispensed with much useless stuff, coming to us with our old metrology; is it not better to continue to amend what we have, to encourage the uniformity so desirable, rather than to attempt to make all things new, but in no respect practically better, at so frightful a cost?"

Heating and Ventilating a City Residence

A Type of Indirect Heating

An article describing the heating plant for the new Harlem Hospital, which appeared in a recent number (June, 1905), referred to a rather unique method of installing ventilating ducts in what are practically brick tunnels built around the sides of the basement.

The same method has been adopted with equal success in heating and ventilating private residences. Such a plant is described in the following article, the residence being that of G. L. McAlpin, Esq., at 9 East Ninetieth street, New York city.

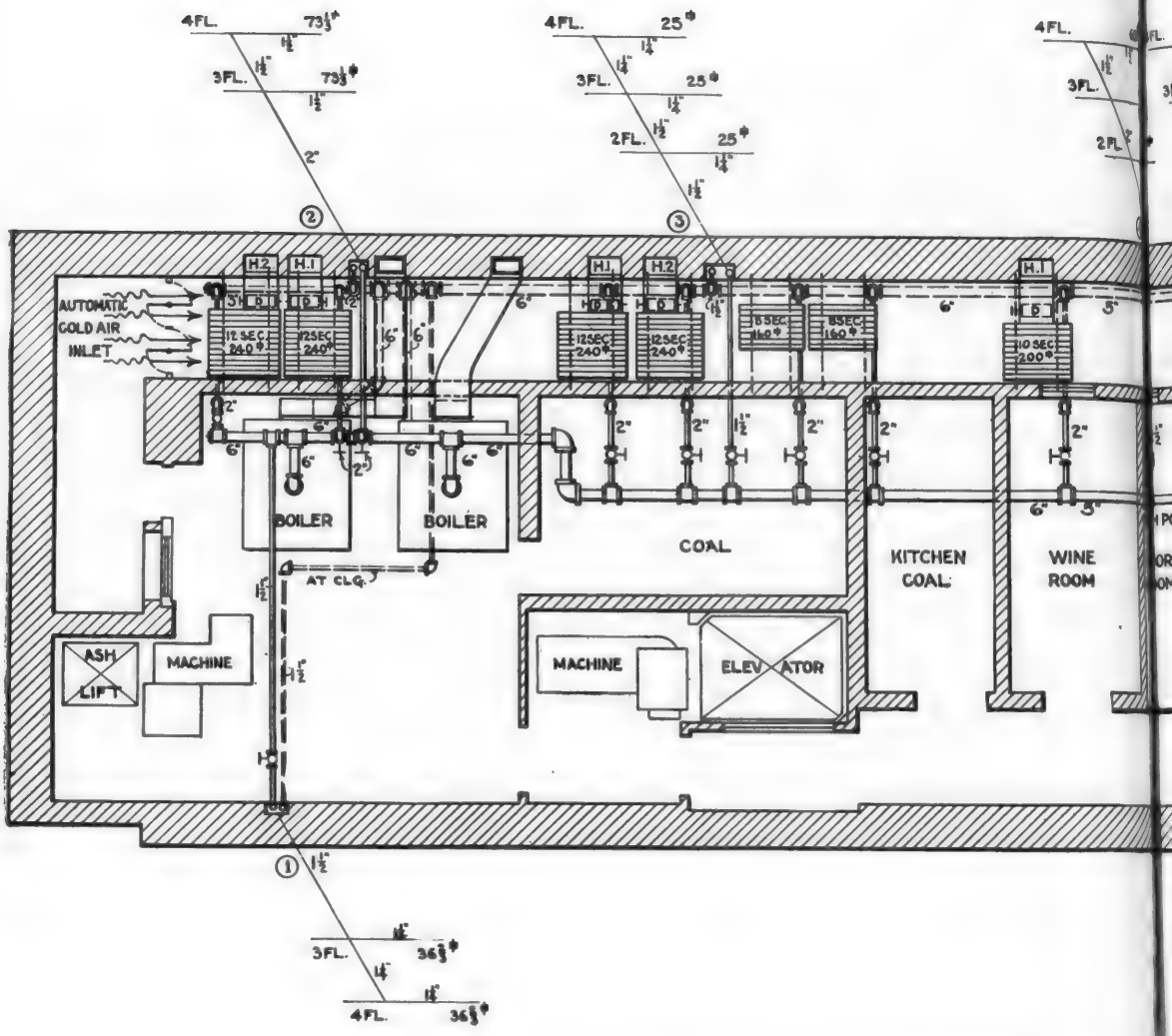
As in the Harlem Hospital building, the main object was to eliminate, as far as possible, the presence of ducts and pipes in the basement. This has been accomplished by the construction of a tunnel, running the entire length of the house, with openings at each end into the outer air, in which tunnel most of the heating apparatus is enclosed.

ARRANGEMENT OF INDIRECT RADIATING CHAMBER

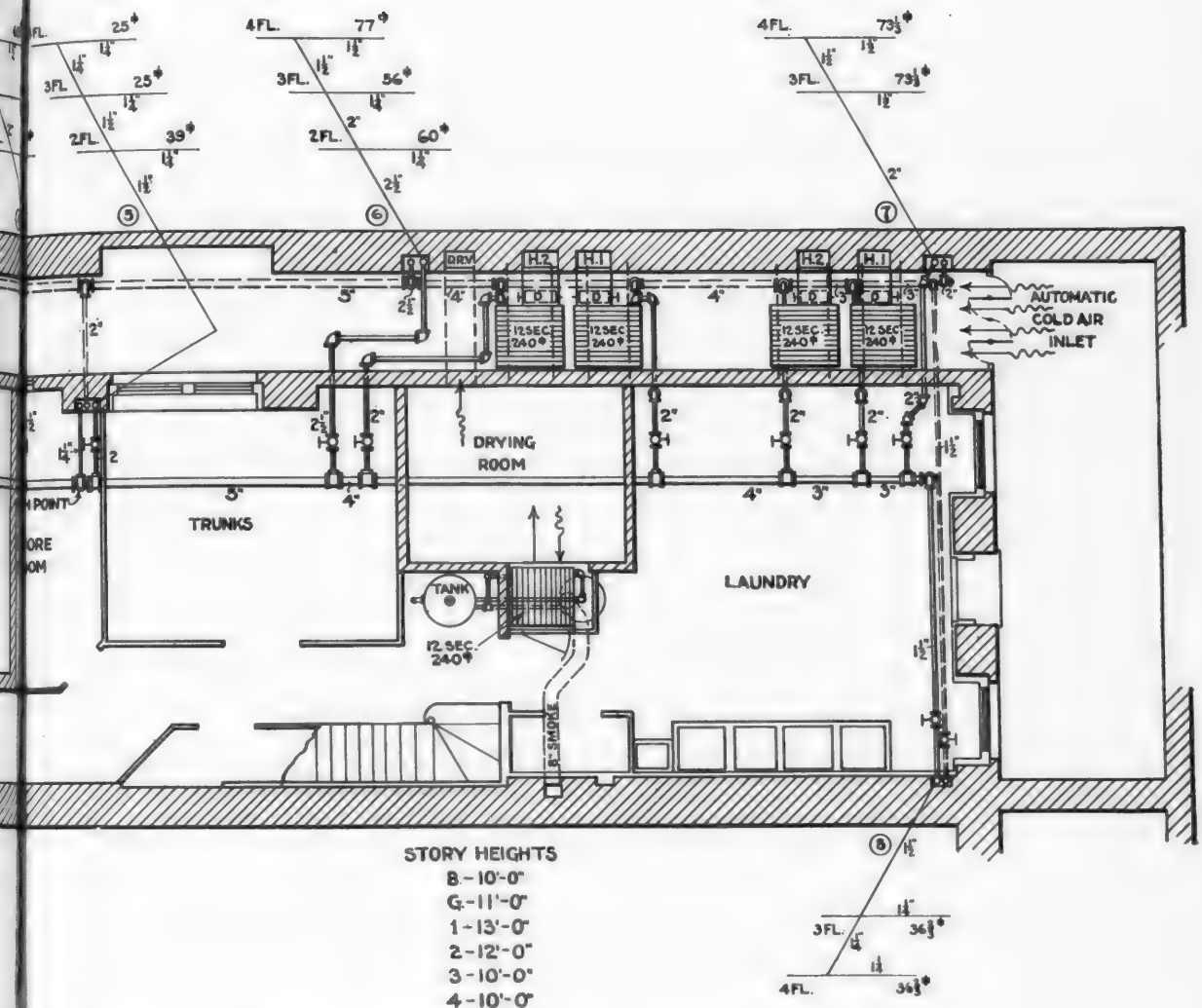
The house is a typical four-story and basement city residence. It is heated principally by an indirect hot water system, the steam being furnished by two low pressure boilers. The boilers are located in the basement proper, whence the hot water main is carried through a wall, which, as stated, runs the entire length of the basement, forming an indirect radiating chamber and cold air supply, the cold air being taken from each end of the chamber. The cold air dampers, located in the cold air inlets, are so arranged that they may be opened or closed by hand, independently of any automatic system of control. They are also controlled by the Johnson thermostatic system, so that when the water heating apparatus falls below 100° F., the cold air inlet dampers close automatically.

INDIRECT RADIATORS

The indirect radiators are those of the "School Pin" pattern, and are installed in sections, containing 20 square feet of surface each, the depth of each section being 15 inches, the length 36 inches and the distance from center to center 3 inches. The connections between the sections are equal to the area of a two-inch pipe, top and bottom. The inlet and outlet are at opposite sides. The number of sections and the number of square feet of surface, based on 20 square feet of surface to a section, are shown in the accompanying reproduction



HEATING AND VENTILATING A CITY RESIDENCE PLAN OF



ENT, SHOWING CONSTRUCTION OF INDIRECT RADIATING CHAMBER.

of the plans. All of the indirect radiators are supported on four-inch I beams, built four inches into the walls.

Each group of indirect radiators has a gate valve in both the flow and return pipes, which are always of the same diameter. In addition to these valves, there is a Johnson automatic valve to each indirect radiator, placed in the return pipe between the two gate valves.

The flow connection to each indirect radiator has a downward pitch to the radiator, leaving the bottom or the side of the main flow pipe, and thus obviating the use of air valves. The indirect radiators are enclosed in galvanized iron boxes. The tops of the casings are formed by 7/8-inch pine boards, covered with tin. This insulator is fastened to the ceiling, leaving a one-half inch space, and the indirect radiator casings are suspended therefrom. Each casing has an observation door above the radiator.

HEAT AND VENT FLUES

All vertical heat and vent flues are lined with galvanized iron. As the positions at which the registers were to come through the wall were not accurately determined, the heat flues were run as high as the ceilings, and the register collars and extensions to the facings of the registers were cut into them and made to fit the registers and the center of the panels afterwards, when the positions of the same were known.

This rule was also followed in the installation of the ventilating flues.

DIRECT RADIATION

Certain parts of the house, as shown by the plans, are warmed by direct radiators.

CONSERVATORY COIL

In a conservatory on the first floor there is an amount of heating surface equal to 140 square feet; 100 square feet of this surface is arranged in short, partly circular radiators, arranged under the benches in the bay window and connected together so as to be practically one continuous bow radiator. It is supplied with two-inch connections, with stop valve at each end together with a Johnson thermostatic valve and thermostat to control the same, and is otherwise treated as a direct radiator.

The remaining 40 square feet of heating surface is disposed of in a coil or loop running up one side of the bay window, returning on the other side and made to correspond to the curves in the sash, the object being to provide a little heat at the upper part of the conservatory window. This pipe is 1¼ inches in diameter and has a stop valve at a point in the circuit to interrupt and modify the flow of the water. The coil also has an air cock at the highest part of the system.

The return pipe from each direct radiator drops one story before entering the return rising line.

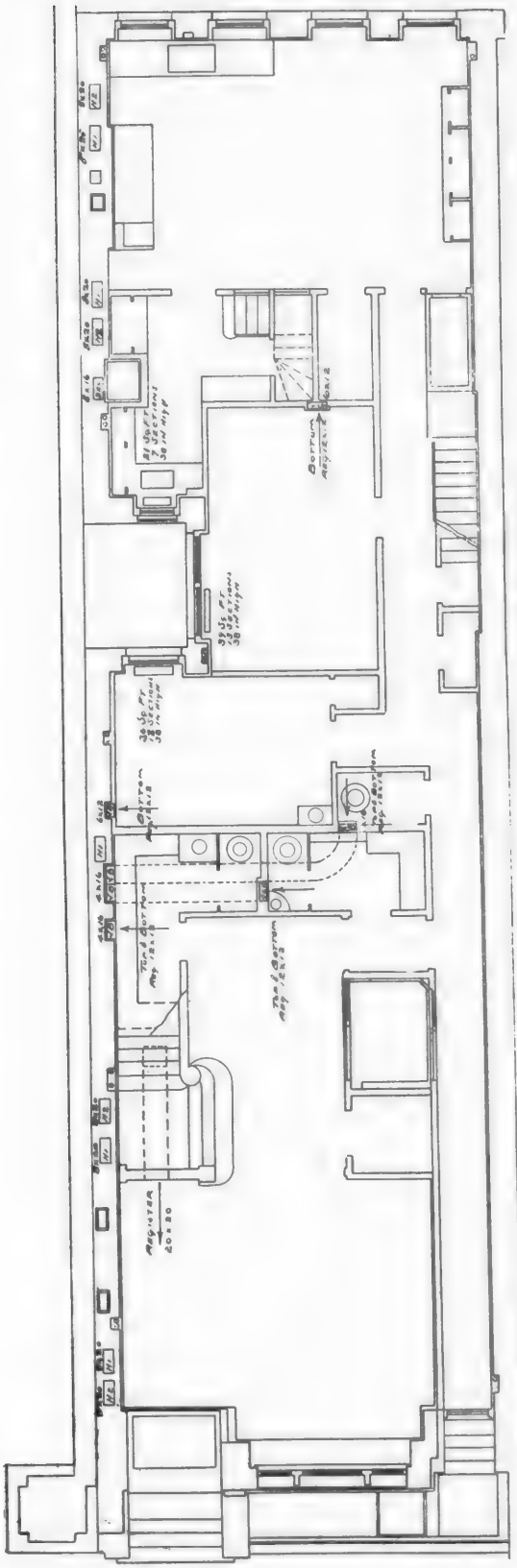
The expansion tank is placed near the ceiling in the tank room on the top floor. It is designed to be of a size equal to hold an amount of water corresponding to one-twelfth of all the water in the heating apparatus. It is made of galvanized iron, with overflow pipe to roof. The tank has a separate 1¼ inch pipe, running from the flow main in the cellar, at a point inside all valves. This pipe connects in the side of the tank near the top and also into the bottom of the tank. The overflow pipe is 1¼ inches in diameter.

VENT PIPES

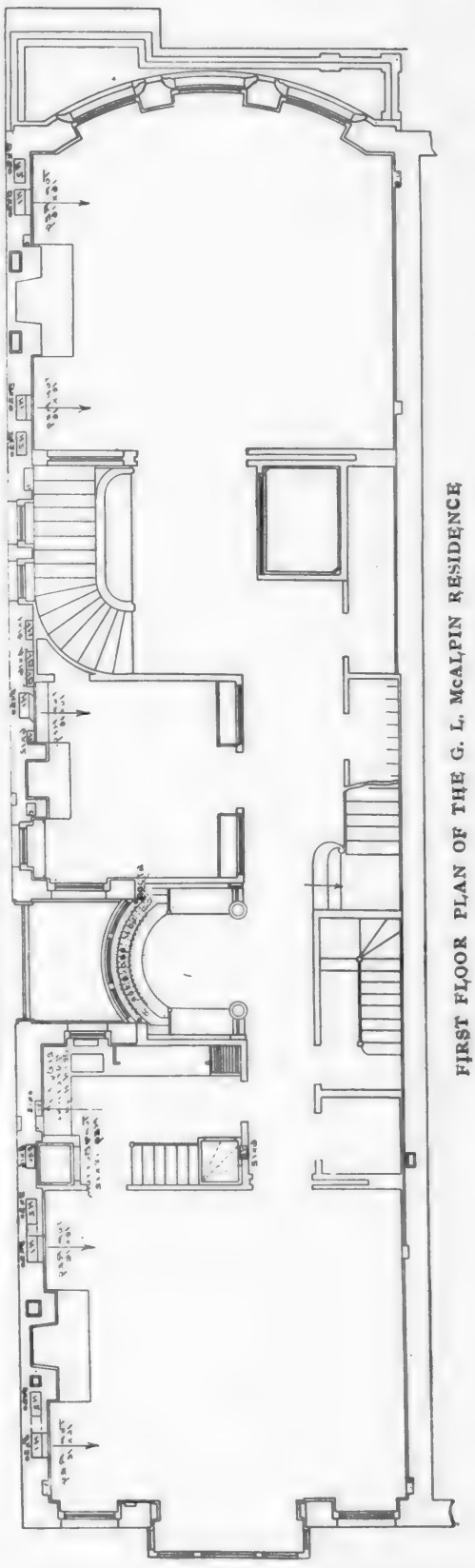
The vent pipes that extend through the roof are made of copper and the part seen above the roof is crimped so as to resemble clapboards, ending in a suitable heading. This is also the finish of the vent flue linings of the masonry flues.

SYSTEM THERMOSTATICALLY CONTROLLED

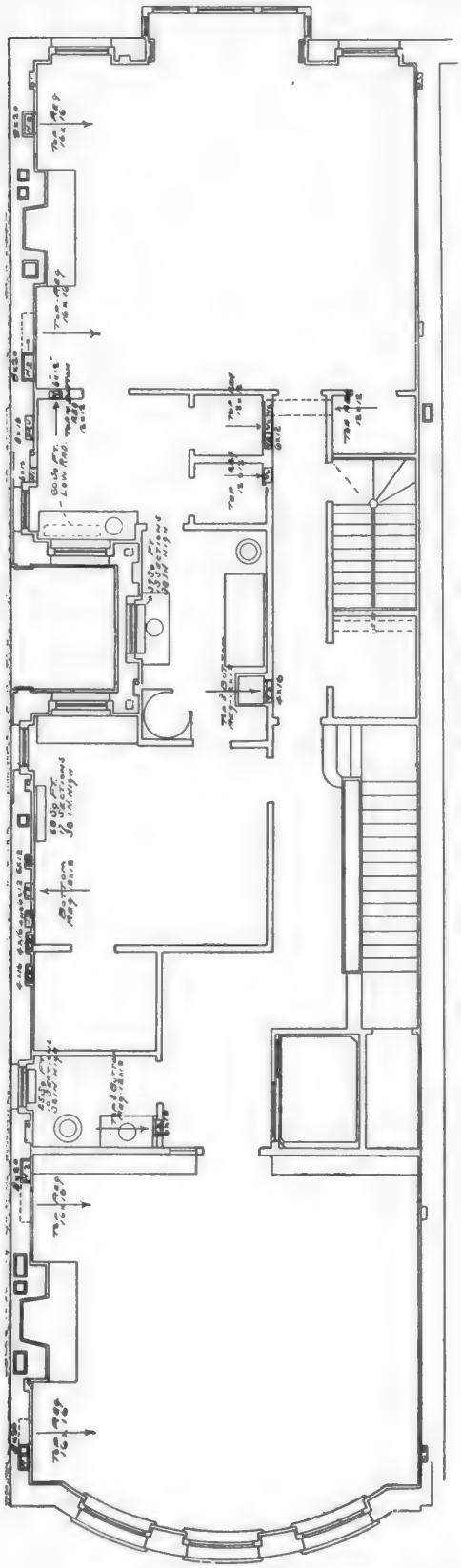
All of the indirect radiators and certain of the direct radiators are thermostatically controlled. Each radiator so con-



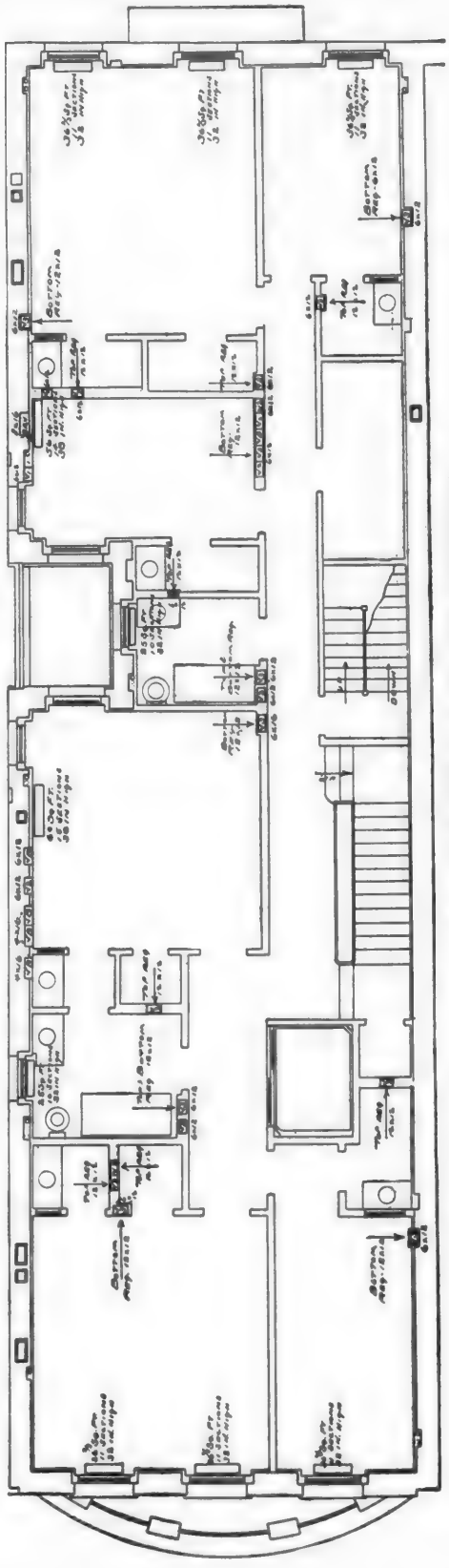
GROUND FLOOR PLAN OF THE G. L. McALPIN RESIDENCE



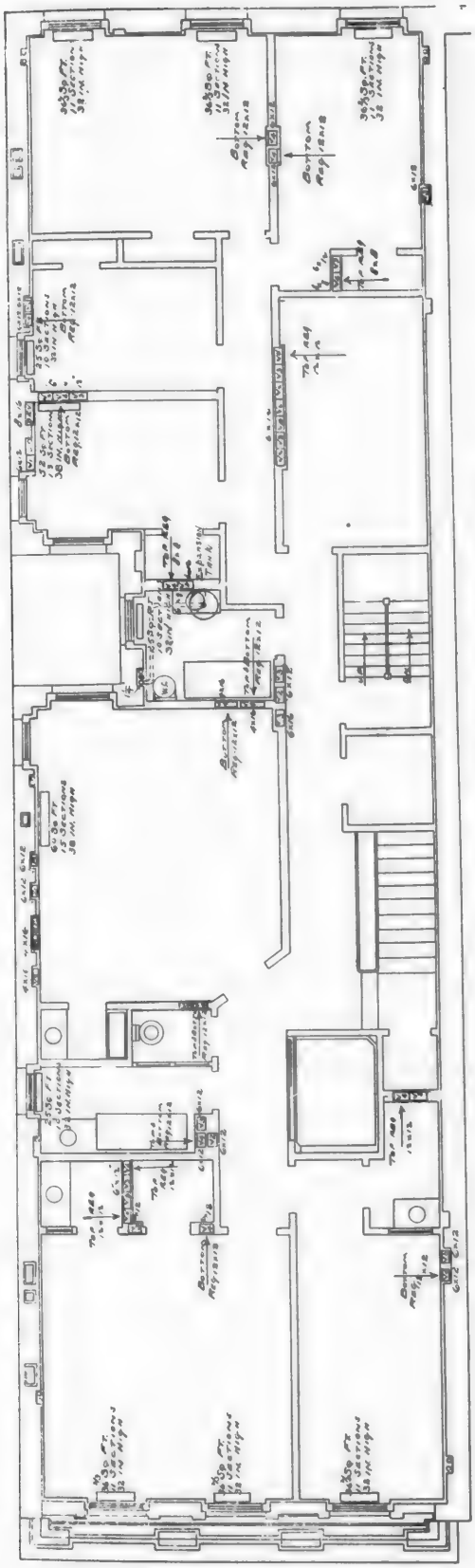
FIRST FLOOR PLAN OF THE G. L. McALPIN RESIDENCE



SECOND FLOOR PLAN OF THE G. L. McALPIN RESIDENCE



THIRD FLOOR PLAN OF THE G. L. McALPIN RESIDENCE



FOURTH FLOOR PLAN OF THE G. L. McALPIN RESIDENCE

trolled has but one thermostatic valve and interrupting valve placed near the radiator, so as to be the least objectionable in appearance in the case of the direct radiators, and, in the case of the indirect radiators, to be in the most convenient position for observation and manipulation.

DOMESTIC HOT WATER SUPPLY

The supply of hot water is obtained independently of the boilers or range. A small hot water boiler is used to heat a tank for laundry and other purposes, and a coil containing 12 sections of indirect radiators supplied by this boiler gives the required drying room service.

The hot water tank is 30 inches in diameter by 6 feet between the heads. The top is convex and the bottom concave. It is made of mild flange steel 3/16 inch thick, and is furnished with a ¾ inch safety valve, set at 50 lbs. pressure. A 2½-inch connection from the upper part of the indirect radiator is made with the upper part of the tank, in such a manner that the air will pass from the boiler into the heating tank. This pipe is supplied with a gate valve.

The rectangular enclosure in which the boiler and indirect radiators are set, is of galvanized iron. It is practically an entire box, floor, sides and top. The open or inside connects by two openings with the drying room, each opening having an area of about 6 square feet. On the hall side of the box is a small door that shuts against the indirect radiators and gives access under the radiators and to the piping. A ventilating flue, 8x16 inches, runs from the drying room to the top of the house.

All of the boilers, flow and return mains, branches and fittings are covered with asbestos air cell sectional covering.

The plant was designed by Mr. William J. Baldwin. Mr. George Keister is the architect and Walker & Chambers the contracting engineers.

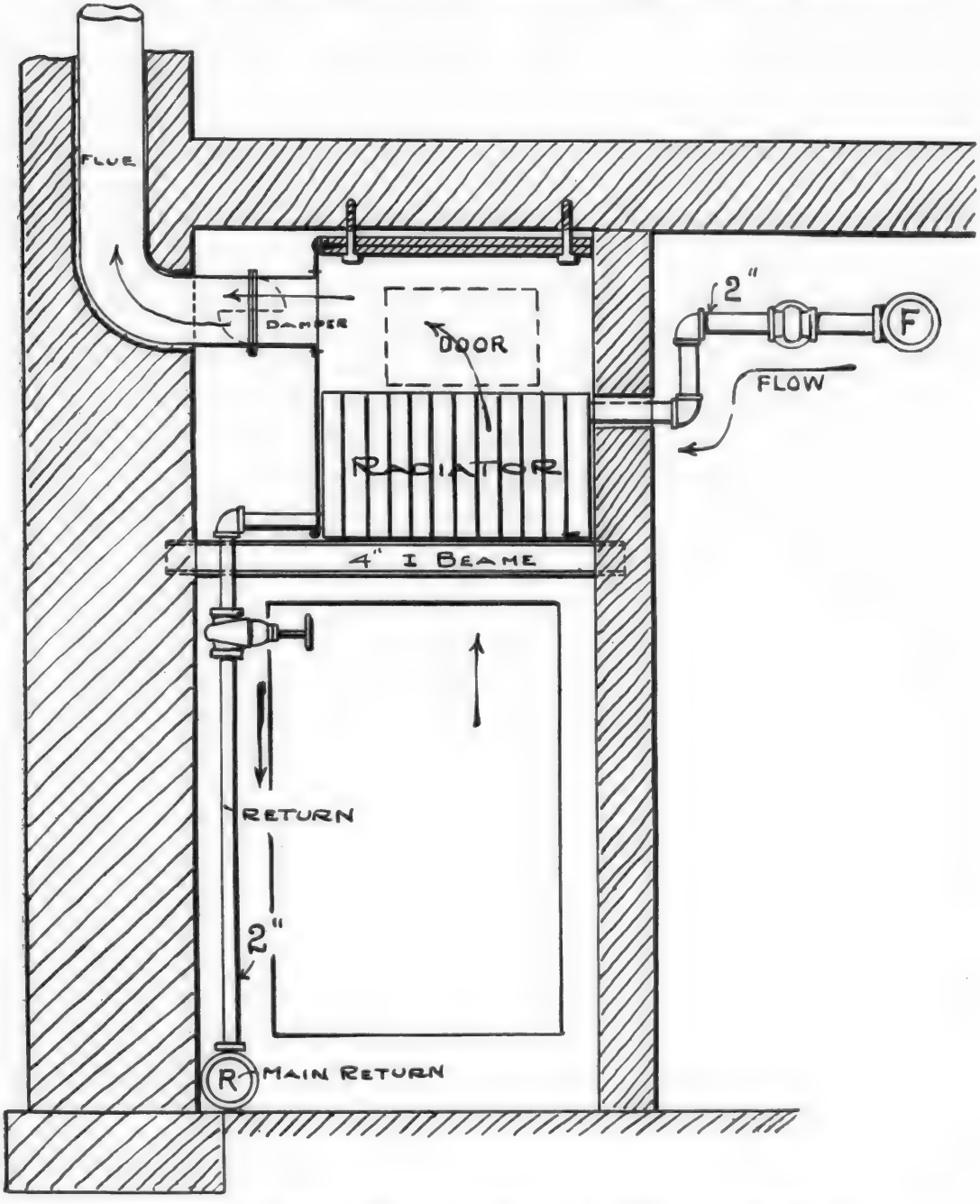
How to Ventilate New York's Subway

James W. Neill, a western mining engineer of long experience, who is in charge of the Heinze mining properties in Butte, Mont., gave some interesting opinions recently to a New York reporter.

"Just at present," he said, "it is the sights and sounds and smells of the Subway which interest.

"The lighting of trains is excellent, and also most of the stations. The roar of the trains is fearful, and all New Yorkers will soon be as deaf as boilermakers always are. The smell of the bore is at present largely that of fresh concrete and stale air. The former will, of course, soon pass away, but the ventilation is so bad that the air is surely dead.

"The bore reminds one of the air in a bottle. Blow as you will across the top, the air below does not move, and the



SECTION THROUGH HEATING CHAMBER, G. L. McALPIN RESIDENCE

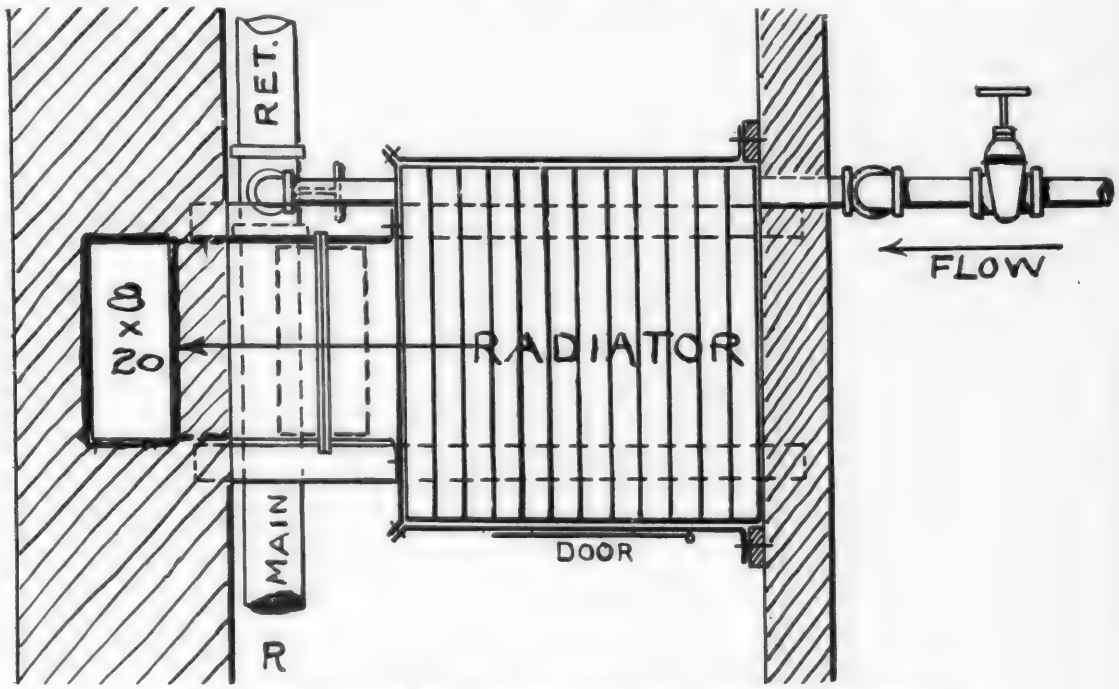
only result is a whistle. To get a current of air which will move steadily in one direction is what is needed.

"In mining work we have the same problem, only with us our subway is turned up on end, and we call it a 'shaft'; if sloping, a 'slope' or an 'incline.' In many places we are forced to ventilate a large mine through one such shaft, and we meet the same conditions as now exist in the Subway, viz.: trains (cages and buckets) which pass each other up and down at great speed, and openings at the sides (stations or drifts) through which traffic and air come and go.

"In our shafts we usually have three compartments, two for hoisting and one for pumping, and unless we put in a partition separating these, we lose all air circulation. By this simple remedy I recently changed the temperature of a shaft from the point where it was not possible to work to one of comparative comfort.

"I have no doubt that it will be necessary to divide the Subway by a partition into two tunnels. At the stations these would be largely of glass; for the rest of the distance either a brick wall or, if it did not add to the noise of the trains by rattling in the current of air, corrugated iron set between the steel columns.

"In each side of this double tunnel the trains would travel in the same direction; i. e., one side up and the other side always down. Thus there would be a natural tendency to sweep the air along always in the same direction, and this would bring it to the station openings, and thus out. But these outlets are at present ridiculously insufficient. Take, for instance, the station at Grand Central. There are four openings to the street. Each is about 6x10 feet, or 240 square feet to the four, whereas the station is surely 100x20, or 2,000 square feet in section. No wonder that no air goes down into that hole and very little comes out. Over each of the little kiosk-like entrances should be set a tower ten feet square and twenty feet high, with large ventilating or entirely open sides. Through these there would be some air circulation, and other such towers should be placed at other intervals along the bore. After the partition is in the bore, the ventilating tower at the end of the station just reached by the train should have a higher tower, as from this end will come the air drawn through by the trains, and this air should be urged to escape up the exit and through the tower. A draught thus started should become permanent and would cost nothing for maintenance, as the trains would aid, not impair, the current of air.



PLAN OF SECTION OF HEATING CHAMBER, G. L. McALPIN RESIDENCE

"As it now is, with the air bottled up by totally inadequate openings to daylight, and the trains fanning the air like bats in a dark room in all directions, it is no wonder the Subway is unsavory, and ere long will be worse than that.

"To attempt to move the air in the Subway by means of fans, without first placing a partition and enlarging the openings to the surface, would do little good, and cost a great deal for power and maintenance."

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NOW that the Standardization Committee appointed by President Gormly, of the Master Fitters' Association, has had time to consider the work laid out for it, some of the difficulties of the undertaking are beginning to be realized. As was stated in our announcement of the appointment of the committee in the August issue, the agitation of the subject sprang from two sources and followed somewhat different lines. The Boston master steam fitters, for instance, spoke more particularly of the failure of the pipe manufacturers to live up to the established standards for weights of wrought iron and steel pipe, while Mr. James W. Curran, of New York, speaking for many of his colleagues, dwelt on the irregularities in the weights and tappings of fittings, together with the varyings in the weights of valves.

It seems probable the members of the committee will decide to devote the major part of their efforts in the latter direction, and here will be found the real opportunity for the committee's usefulness.

The matter of standard pipe and pipe threads has been pretty thoroughly threshed out in this country, as will be seen from the review of the subject in another column. The most, therefore, that the committee can do, in this direction, is to remind the pipe manufacturers of their vows, as it were, and induce those of them who have wandered away from the narrow path to retrace their steps.

In the matter of tappings for fittings, however, and weights for fittings and valves, there lies an opportunity for some constructive work of the first order, for, according to statements made by Mr. E. M. Nichols, of Philadelphia, over nine-tenths of the contingent losses of the steam fitting trade to-day are due to the very irregularities referred to in the construction of these goods.

It is gratifying to note that the people most directly, if not most vitally, affected—the manufacturers—are taking a lively interest in the subject, many of them having already responded favorably to the committee's letter of inquiry. Thus a good start has been made, although if we were to pick out the most troublesome stumbling block in the enterprise we should say it would come up in the standardizing of valves.

THE residence heating plans, reproduced in this issue, are really a sequel to those designed for the new Harlem Hospital build-

ing, in New York. In both cases the objects sought have been practically the same—that is, the elimination, as far as possible, of ducts and pipes in the basement. What is of special interest in the residence plans, is the location of the cold air inlets at each end of the lengthy cold air chamber which puts the finishing touches of compactness on a system that is equally neat and compact in other respects.

PERIODICALLY the possible adoption of the metric system in this country is agitated by technical journals, the interest in it kept alive for a time by spirited discussions pro and con and then the matter allowed to subside as quickly as it arose. Englishmen and Canadians are in the midst of such an agitation just now, owing to the strenuous efforts being made by the Decimal Association of England to have the use of metric system made compulsory by law. Indeed, so successful have been the efforts of this association up to date that a bill to compel the adoption of the metric system in Great Britain has passed the House of Lords and is now before the Commons.

American engineers will watch the course of the bill with deep interest. Up to the present time it may safely be said that not one reputable engineer in a hundred on this side of the water has considered it practicable, or even possible, to adopt the metric system in the United States. Yet their arguments apply with almost equal force to the British situation, and the possibility that Great Britain may adopt the metric system has no doubt led many of the engineering fraternity in America to reconsider their views upon the subject.

On account of the renewed discussion of this matter, our readers will be interested in what is popularly considered to be the best defense of the American position in opposition to the metric system that has been written. This paper, entitled "The Metric System—Is It Wise to Introduce It Into Our Machine Shops," and read by Coleman Sellers, before the American Society of Mechanical Engineers, will be found on another page.

"THE Progress of American Schools in Regard to Health Laws," is the title of a paper read by Mr. J. D. Sutcliffe, of Manchester, Eng., at the fall meeting of the British Institution of Heating and Ventilating Engineers, on October 17. In this paper Mr. Sutcliffe reviews his seven weeks' tour of the Eastern and Central States and refers to typical school buildings he visited in Chicago, New York and Boston. He also brings to the attention of English engineers the laws for the regulation of heat and ventilation now on our statute books, and asks when England's "education authorities are going to wake up to the vital necessity of fixing some definite health standard for all our schools."

Comparing the methods of school warming in vogue in this country, Mr. Sutcliffe says of the plenum plants he visited in Chicago: "One cannot altogether agree with the methods that are most in favor. As an example, all the heating surface is placed at one point in the basement," as a result of which "the hot air has to be delivered into the rooms at a temperature of from 150° to 170° F."

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

WHO HELPS ME I HELP

THE STANDARDIZATION COMMITTEE HOLDS ITS FIRST MEETING — PRECEDENTS THAT WILL GUIDE THE WORK — THE BRIGGS STANDARD

The Standardization Committee appointed by President Gormly, which has under way the preparation of a schedule of standards for pipes and weights and tappings for valves and fittings, has started out on its undertaking by communicating with the representative manufacturers of these goods throughout the country, with the purpose of enlisting their co-operation. Already enough answers have been received to assure the committee that its efforts will be heartily backed by the trade at large.

The further course of procedure of the Committee will, no doubt, to some extent follow that which was taken at the time pipe and pipe threads were originally standardized in this country, and more recently at the time of the establishment of the present schedule for flanges and flanged fittings. In the former case, the undertaking originated with the American Society of Mechanical Engineers. This society at its sixth annual meeting, in 1885, appointed a committee, consisting of Frederick Grinnell, Chairman; George Schuhmann, William J. Baldwin, B. H. Warren, and George M. Bond, Secretary, who were directed to confer with manufacturers of pipe dies and pipe fittings with a view of bringing about a uniformity in the sizes of pipe and pipe threads and of maintaining it by the use of gauges, which would definitely represent standard sizes.

THE BRIGGS STANDARD FAVORED

At an early meeting of the committee the Briggs standard of pipe threads, which nearly all, if not all, of the pipe manufacturers once adopted, was decided to be the proper standard to adhere to. This point settled, the committee sent a circular letter to the manufacturers of wrought-iron pipe in the United States, expressing their views and asking that the pipe manufacturers appoint a committee and arrange for a mutual conference.

Another circular letter was sent to the members of the Associated Manufacturers of Cast and Malleable Iron and Brass Fittings in the United States, asking for their views upon the subject.

THE MANUFACTURERS' COMMITTEE

The pipe manufacturers at once appointed a committee, on which, it will be remembered, appeared the names of L. W. Shallcross, Chairman; J. H. Flager, L. J. Piers, and James H. Murdock, Secretary.

The agitation also resulted in action by the Cast Iron Fittings Association, which, at a meeting held soon after in New York, appointed a committee of five to take into consideration the matter of a standard gauge of threads. On this committee were: R. T. Crane, C. C. Walworth, E. G. Burnham, Charles Jarecki and Carleton W. Nason.

In addition to this, action was taken by the Manufacturers of Brass and Iron, Steam, Gas and Water Works of the United States, who unanimously resolved "that this Association favors the establishment of a universal wrought-iron pipe gauge, to be used as a standard throughout the United States, and that any action taken by the manufacturers of wrought-iron pipe to accomplish this object shall have our hearty co-operation."

THREADS OF VARIOUS MANUFACTURERS COMPARED

As early as June, 1886, a joint conference of the committee appointed by the pipe manufacturers and that of the Mechanical Engineers resulted in the adoption of the motion to the effect that each manufacturer should send to the Pratt & Whitney Company, in Hartford, sample pieces of their pipe, from six inches diameter down, threaded on one end, to be tested by the Pratt & Whitney Company with the Briggs standard and a report made to each manufacturer of the state of his gauges.

THE BRIGGS STANDARD FOUND TO BE PRACTICABLE.

The examination and test of these sample pieces was made, although, for obvious reasons, the full results of the test were not made public. It was shown, however, that the variation from the Briggs standard, as found to exist under this test, did not warrant a departure from the original standard represented by the Briggs gauges, and confirmed the opinion of the Mechanical Engineers' committee that the Briggs standard could be adhered to. In fact, with the exception of the three-quarters and one inch sizes, but comparatively little change was required in the dies.

FIRST DEFINITE ACTION BY THE PIPE MANUFACTURERS

To clinch the matter, a joint conference was called, in October, 1886, of all

the interests involved, including the committees of the Pipe Manufacturing Association, the Cast Iron Fittings Association, the Brass Manufacturers' Association and Mechanical Engineers' Society. Here it was unanimously resolved that a common standard be adopted, but that action should proceed first from the pipe manufacturers. It happened that there was a meeting of the pipe manufacturers about to be held in Pittsburg. At this meeting it was formerly resolved that the wrought-iron pipe manufacturers of the United States adopt the Briggs standard of gauges, and that, where any manufacturer has, from any cause, got away from that standard, he be requested to get such corrections made as soon as possible, so as to conform to the Briggs standard.

A SET OF STANDARD GAUGES ORDERED

This action was later indorsed by the brass manufacturers, who agreed to "act in conformity with the resolution adopted by them" (Pipe Manufacturers' Association). The brass manufacturers also authorized their secretary to correspond with the secretaries of the Wrought-Iron Pipe, Cast-Iron Fittings and Malleable Fittings Associations with the idea of securing a set of Standard Gauges, and that such set of gauges be presented to the American Society of Mechanical Engineers for reference. This was done, and the Briggs standard has since been made the universal one for pipe threads in this country.

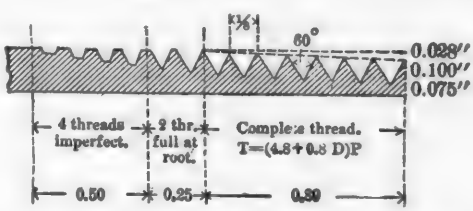
THE BRIGGS STANDARD

In this connection, it will be no doubt interesting to recall the paper of the late Robert Briggs, presented and read after his death before the Institution of Civil Engineers of Great Britain, on "American Practice in Warming Buildings by Steam." It was this paper that contained the following data, upon which the Briggs standard pipe thread sizes are based:

"The taper employed for the conical tube-ends is uniform with all makers of tubes or fittings, namely, an inclination of 1 in 32 to the axis. Custom has established also a particular length of screwed end for each different diameter of tube. Tubes of the several diameters are kept in stock by manufacturers and merchants, and form the basis of a regular trade in the apparatus for warming by steam. A knowledge of all these particulars is therefore essential for designing apparatus for the purpose. The ruling dimension in wrought-iron tube work is the external diameter of certain nominal sizes, which are designated roughly according to their internal diameter. These nominal sizes were mainly established in the English tube trade between 1820 and 1840, and certain pitches of screw-thread were then adopted for them, the coarseness of the pitch varying roughly with the diameter, but in an arbitrary way utterly devoid of regularity. The length of the screwed portion on the tube end varies with the external diameter of the tube according to an arbitrary rule-of-thumb; whence results, for each size of tube, a certain minimum thickness of metal at the outer extremity of the tapering screwed tube-end. It is the determination of this minimum thickness of metal, for the tapering screwed end of a wrought-iron tube, which constitutes the question of mechanical interest.

"A longitudinal section of the tapering tube-end, with the screw-thread as actually formed, is shown in the illustration for a nominal 2½-inch tube, that is, a tube of about 2½ inches internal diameter, and 2⅞ inches actual external diameter.

"The thread employed has an angle of 60°; it is slightly rounded off both at the



THREAD OF 2½-INCH TUBE, FULL SIZE

top and bottom, so that the height or depth of the thread, instead of being exactly equal to the pitch, is only four-fifths of the pitch, or equal to $0.8 \times \frac{1}{n}$, if n be the number of threads per inch. For the length of tube-end throughout which the screw-thread continues perfect, the empirical formula used is $(0.8\,D + 4.8) \times \frac{1}{n}$, where D is the actual external diameter of the tube throughout its parallel length, and is expressed in inches. Further back, beyond the perfect threads, come two having the same taper at the bottom, but imperfect at the top. The remaining imperfect portion of the screw-thread, furthest back from the extremity of the tube, is not essential in any way to this system of joint; and its imperfection is simply incidental to the process of cutting the thread at a single operation. From the foregoing it follows that, at the very extremity of the tube, the daimeter at the bottom of the thread,

$$D - \left[\frac{2\times(0.8D+4.8)}{32\,n} + \frac{2\times 0.8}{n}\right] = D - (0.05\,D + 1.9)\times\frac{1}{n}.$$

The thickness of iron below the bottom of the thread, at the tube extremity, is empirically taken to be $= 0.0175\,D + 0.025$. Hence the actual internal diameter d of any tube is found to be, in inches,

$$d = D - (0.05\,D + 1.9) \times \frac{1}{n} - 2 \times (0.0175\,D + 0.025),$$

or,

$$d = 0.965\,D - 0.05\,\frac{D}{n} - \frac{1.9}{n} - 0.05.$$

"For the various sizes of tubes, ranging from ⅛ inch to 10 inches nominal internal diameter, with their corresponding numbers of screw-threads per inch, the actual internal diameter *d* is expressed by the following Table I in terms of the actual external diameter *D*:

cepted from customary usage. It is the workman's approximation to the pitch practically desirable, and much reluctance must consequently be felt in calling it in question. Still it would have been better to investigate the general case upon the basis of a pitch ranging in closer accordance with the range of tube diameter. Thus the nominal ½-inch tubes might have had 16 threads per inch; ¾-inch, 14 threads; 1 and 1¼-inch, 12 threads; 1½ and 2 inches, 11 threads; 2½ to 3½ inches, 10 threads; 4 to 6 inches, 8

TABLE I

DIAMETERS OF WROUGHT-IRON WELDED TUBES

Nominal Internal Diameter of Tube.	Number of Screw-threads per Inch.	Actual Internal Diameter *d* in Terms of Actual External Diameter *D*.
Inches.	*No.*	*Inches.*
⅛	27	$d = 0.9631\,D - 0.1204$
¼ and ⅜	18	$d = 0.9622\,D - 0.1556$
½ and ¾	14	$d = 0.9614\,D - 0.1857$
1, 1¼, 1½ and 2	11½	$d = 0.9607\,D - 0.2152$
2½ to 10	8	$d = 0.9587\,D - 0.2875$

"The figures derived from this statement, which are of importance for practical use, are presented in detail in the

threads; 7 to 9 inches, 7 threads; and 10 inches, not more than 6 threads per inch. The existing numbers of threads, how-

TABLE II

STANDARD DIMENSIONS OF WROUGHT-IRON WELDED TUBES

DIAMETER OF TUBE.			THICKNESS OF METAL.	SCREWED ENDS.	
Nominal Inside.	Actual Inside.	Actual Outside.		Number of Threads per Inch.	Length of Perfect Screw.
Inches.	Inches.	Inches.	Inch.	No.	Inch.
⅛	0.270	0.405	0.068	27	0.19
¼	0.364	0.540	0.088	18	0.29
⅜	0.494	0.675	0.091	18	0.30
½	0.623	0.840	0.109	14	0.39
¾	0.824	1.050	0.113	14	0.40
1	1.048	1.315	0.134	11½	0.51
1¼	1.380	1.660	0.140	11½	0.54
1½	1.610	1.900	0.145	11½	0.55
2	2.067	2.375	0.154	11½	0.58
2½	2.468	2.875	0.204	8	0.89
3	3.067	3.500	0.217	8	0.95
3½	3.548	4.000	0.226	8	1.00
4	4.026	4.500	0.237	8	1.05
4½	4.508	5.000	0.246	8	1.10
5	5.045	5.563	0.259	8	1.16
6	6.065	6.625	0.280	8	1.26
7	7.023	7.625	0.301	8	1.36
8	7.982	8.625	0.322	8	1.46
9	9.000	9.688	0.344	8	1.57
10	10.019	10.750	0.366	8	1.68

Taper of conical tube-ends, 1 in 32 to axis of tube.

accompanying Table II in a convenient order for reference.

"The number of screw-threads per inch for the several sizes of tubes is here ac-

ever, as given in Tables I and II, are now too well established to be disturbed; at all events, they must be taken in any statement of present practice.

CORRESPONDENCE

Accepted letters for this department containing practical suggestions or relating experiences that are of value to those interested in heating and ventilating will be paid for in cash. Such letters should be accompanied by illustrations when possible.

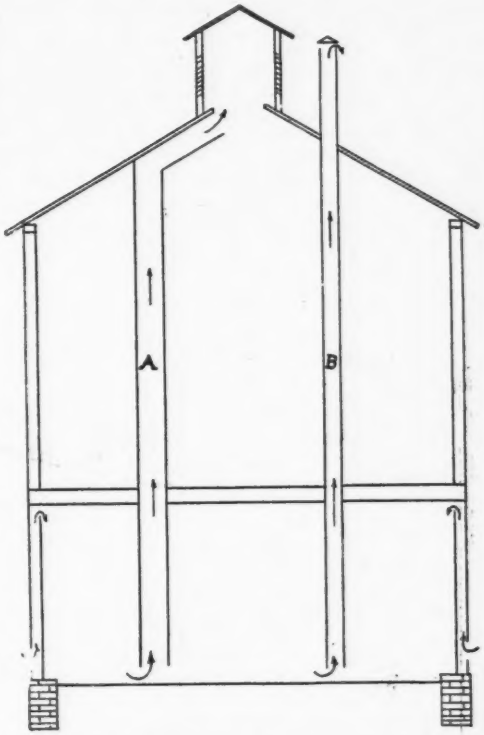
Barn Ventilation

Editor Heating and Ventilating Magazine:

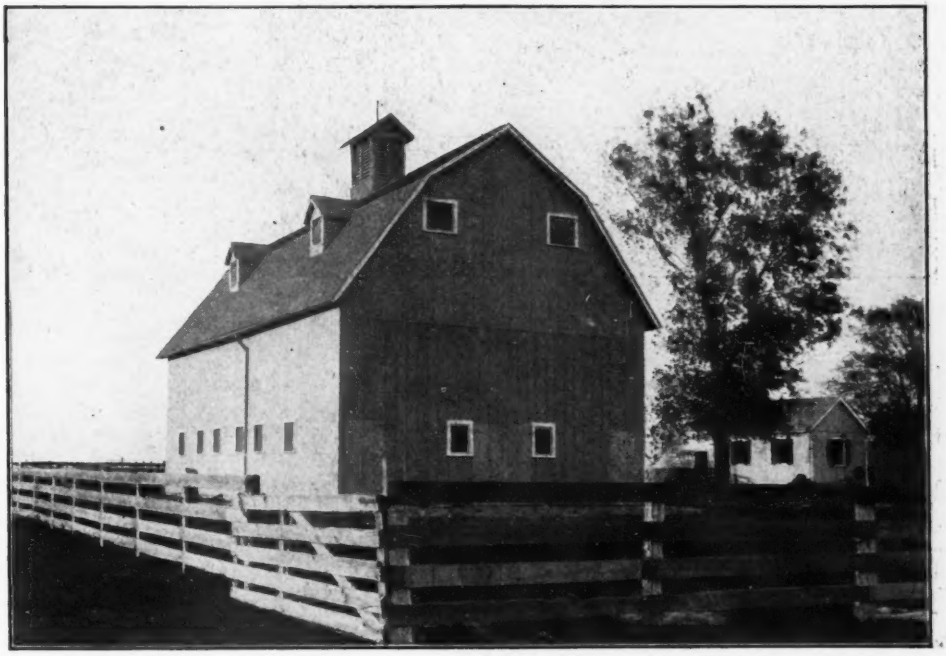
In these days of pure milk and sanitary conditions generally your readers may be interested in a description of the methods that are being adopted to maintain a fresh air supply in barns and other buildings containing horses and cattle. Up to the present time it is seldom that the interior of a barn has been arranged so as to contribute to the comfort of the cows or the production of wholesome milk. Too often the dairy herd is accorded very little or no consideration in this respect, and in a vast majority of cases the animals are housed in the worst of illy ventilated and unsanitary quarters.

A recent bulletin issued from the Illinois Experiment Station by Herbert A. Hopper, assistant in dairy husbandry, gives some valuable hints as to the conditions which should be found in every dairy barn.

Professor Hopper holds that much of the confusion in and about the barn is rooted in the belief that a comfortable and sanitary barn is of necessity expensive, and says that this is an unfortunate



ARRANGEMENT OF FLUES FOR BARN VENTILATION. WHEN THE BARN HAS NO CUPOLA, THE FOUL AIR IS REMOVED AT B, OTHERWISE AT A

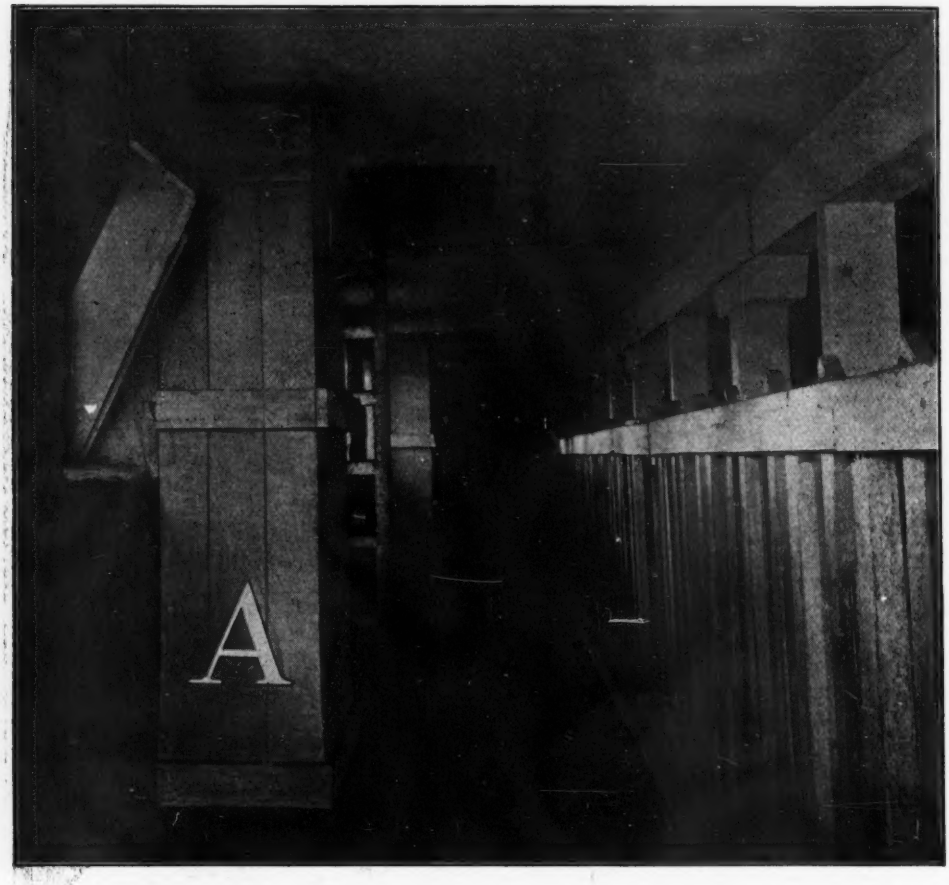


TYPE OF BARN PROPERLY CONSTRUCTED TO SECURE ADEQUATE VENTILATION

impression, for wholesome and convenient quarters can be provided at a very moderate cost. The lighting and ventilation of the dairy barn or stable is placed of first importance. Next comes the necessity of providing tight walls and ceilings and a sound floor. Dairy cows, when crowded into dark and dirty stables, can not be expected to produce as much milk, nor milk with as wholesome properties as those provided with clean, airy quarters, where the sunlight enters through numerous windows and where the foul air of the stable is replaced by pure air without submitting the cows to injurious draughts.

The accompanying cuts, obtained through the courtesy of Mr. Hopper, illustrate the style of barn suggested as an ideal home for a herd of dairy cows. The barn pictured is one of moderate cost, provided with numerous windows, cement floors, and an application of whitewash, and one not beyond the reach of any progressive dairyman. In another illustration is shown a well-planned ventilator shaft for the removal of foul air from a stable. In speaking of ventilation, the circular says:

No barn for live stock should be built or remodeled without planning for some efficient system of ventilation. The stable should be made approximately air-tight, with close-fitting doors and windows. The ceiling should not be more than eight feet high, for when higher than this the warm air generated by the animals rises so far above them that they derive little benefit from it. The most satisfactory system of ventilation is King's, in which the pure air is admitted through openings along the side walls next to the ceiling, and foul air is removed by a flue extending from near the stable floor to the roof. An intake flue two feet square will supply air enough for twenty cows, providing the system is so arranged as to create a good circulation. Since the intakes are small and numerous, to avoid draughts the sum of their areas should be somewhat greater than four square feet, to make allowance for the greater friction in the smaller openings. The outlet ue should have a capacity slightly greater than the sum of the intakes, to ensure sufficient circulation. In case of forty cows, the size of flues should be doubled and two outlet



BARN VENTILATION—VENTILATOR FOR REMOVAL OF FOUL AIR, SHOWN AT A

flues should be used. These should be of wood, not metal, and pass directly through the roof or to the cupola. With this system the fresh air, coming in at points remote from the cows, is warmed before reaching them. The foul air, which is heavy, falls to the floor and passes through the roof by way of the ventilator. In planning a barn for a given number of cows, it is not so much a matter of securing a given number of cubic feet for breathing space as it is to provide sufficient circulation of pure air.

Sunlight is a great purifier and should be admitted freely to all parts of the dairy barn. No part of the stable should be too dark to read a paper easily. This necessitates the placing of numerous windows on all sides of the barn, at least one of ordinary size to every two cows. They should be so arranged that in winter as much sunlight as possible can be obtained from the north and east exposure. The windows must be well fitted into their frames, else difficulty will be met with in keeping the animals comfortable during the severe weather.

GEORGE A. WALKER.

Huntington, Ind.

Seller and Brigg Threads

Editor HEATING AND VENTILATING MAGAZINE:

I note at bottom of Page 32, September issue, an error, stating that the Sellers' triangular thread is used for pipe threads in this country. This is decidedly incorrect, as the Sellers thread is flat top and bottom 1/8th of the pitch, and would not do at all for pipe threads or for fitting threads. The Briggs' Standard is practically a sharp "V" thread, angle, however, being the same as the Sellers—60 degrees included.

GEORGE M. BOND.

Hartford, Conn.

An English Theater Equipment

Sutcliffe Ventilating & Drying Company, Ltd., Manchester, Eng., has sent us an interesting account of a theater equipment it has recently installed in the Stockport Empire Theater, Manchester. Mr. J. D. Sutcliffe, the managing director of this company, who recently completed a tour of some of our Eastern cities, states that he has drawn on his observations of American practice in designing many features of the installation in question. As a result of his inspection of American theaters, the Stockport playhouse, he says, can boast of possessing the most reliable and, probably, the best fireproof curtain in existence. It consists of a solid wall of Bruckner's fireproof slabs, surrounded by an angle iron frame, five inches deep.

The heating includes a low pressure sectional steam boiler, fixed in a fireproof chamber in the basement, and working at from 2 pounds to 5 pounds pressure per square inch. Steam is carried from this boiler to radiators in all parts of the building, including the stage, dressing rooms and entrances. In addition to radiators in the theater proper for warming the auditorium, there are also radiators in the various entrances and corridors, to keep these warm and prevent cold draughts coming in at the doors. The stage is also thoroughly warmed, and what is quite an exception in theaters, all the dressing rooms are heated so as to ensure a comfortable temperature for the artists in all weathers.

Ventilation is provided by a large extractor in the roof, 20 feet high and 5 feet wide at the base. An ample supply of hot water for cleaning and lavatory purposes is obtained by a calorifier connected to the steam boiler. In summer weather, when the boiler and heating plant are not in use, the calorifier is heated by gas, so that hot water is always obtainable. The artists' lavatories are supplied with hot and cold water.

NEW DEVICES

A New Laundry Heater

A new laundry heater, with an unusually large water heating capacity for its size, has just been placed on the market by Kellogg-Mackey-Cameron Company. An interesting feature of the heater is that every part of it is direct fire

LITTLE GIANT LAUNDRY HEATER

surface. The heater is made in three parts, which are easily set up, its simplicity of construction also enabling it to be quickly cleaned. It will burn any kind of fuel. The top is provided with a double griddle and the side spaces will heat from 15 to 20 flat irons. The heater is being made in two sizes, with tank capacities of 125 and 225 gallons, respectively.

TRADE AND MISCELLANEOUS NOTES

Trade Literature

Webster Separators for steam and oil are described in an 8-page folder issued by Warren Webster & Co., Camden, N. J., and containing half-tone illustrations of both types of apparatus. The folder contains some brief but terse remarks concerning the value of separators, the Webster steam separator, by the way, being guaranteed not to leave so much as one per cent. of moisture in the steam.

American Radiator Company, Chicago, is sending out facsimiles of the outside cover pages of a recent number of Collier's Weekly, one of these pages being wholly devoted to an advertisement in colors of American radiators and Ideal boilers. This advertisement is said to be the largest on the subject of steam and hot water warming that has ever been placed before the American reading public. We are informed that the advertisement was duplicated in reduced size in 23 other family magazines having a total of 45,000,000 readers. One of the advantages of this kind of advertising is that it benefits not only the firm directly concerned, but the entire steam fitting trade, by creating an increased demand for steam heat.

"Fowler & Wolfe," originators of wall radiation, is the introductory title of a recent 12-page supplementary catalogue issued by Fowler & Wolfe Mfg. Co., The Bourse, Philadelphia. The booklet is attractively printed in red and black on buff paper and contains detailed information regarding this firm's extensive line of wall radiators, together with numerous half-tone and other cuts covering direct and semi-direct radiators, plate warmers, and brackets and supports. There are also two pages of photographs showing the installation of Fowler & Wolfe wall radiators in various classes of buildings. Size 6x9 inches (standard).

Kellogg - Mackay - Cameron Company, Chicago, Ill., which has recently secured the ownership of the Morgan patents for vacuum steam heating, together with the sale of the Morgan apparatus, has issued two interesting booklets, one a brochure on "Vacuum Heating Fuel Economy" and the other "In Evidence," being a collection of handsome plates of residences, apartments, etc., in which the Morgan system is at present successfully in use, both of which are well worth perusal. This company also has in preparation an interesting book for steam fitters on the practical installation of the Morgan system. It will show working drawings and photographs of the actual apparatus set up, and give full instructions for installing a new plant as well as remodeling old plants. We understand this book will be sent free on request to all who write for it.

"Sun Radiators and Heaters" is the title of a catalogue recently issued by the United States Radiator and Boiler Co., Pittsburg, Pa., containing a great deal of useful information of a technical nature, in addition to very full descriptions, with illustrations, of the extensive line of heating apparatus carried by this firm. Size 6x9 inches (standard). Pp. 100.

Manufacturers' Notes.

Hays Manufacturing Co., Erie, Pa., manufacturer of fittings, is building a new plant at the corner of Twelfth and Liberty streets. The plant will occupy an entire block, and will be completed about January 1. The machine shop will

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Mention HEATING AND VENTILATING MAGAZINE.